

Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices.

aTC425
.P6U51

BT RIVER SUBWATERSHED

of the Potomac River Watershed

Hardy County, West Virginia



WORK PLAN

**FOR WATERSHED
PROTECTION AND
FLOOD PREVENTION**



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
MORGANTOWN, WEST VIRGINIA
OCTOBER 1974

PHOTO NATIONAL

A
G
R
I
C
U
L
T
U
R
A
L



LIBRARY

The scene of farmland
The major purpose of
This photo shows the

Valley.
rural lands.

E

Upper Cove Run flows out of Mathias, W. Va., toward Lost River. One of the five flood prevention structures in the watershed project will be built on this tributary above Mathias and will protect the town.

TOP PHOTO, BACK COVER

The wide, verdant Lost River Valley has picturesque mountains on both sides, creating a magnificent setting. The scene is near Baker. George Washington National Forest lies east of the river.

BOTTOM PHOTO, BACK COVER

The watershed project will protect these residences along Lost River at Lost City. The flood prevention dam nearest Lost City will be enlarged to hold 50 acres of water for recreation, including camping and swimming.

ADDENDUM

LOST RIVER SUB-WATERSHED

WORK PLAN

Hardy County,
West Virginia

U. S. DEPT. OF AGRICULTURE
NATIONAL AGRICULTURAL LIBRARY

AUG 01 1975

CATALOGING - PREP.

Containing:

Discount Rate

Abbreviated Environmental Quality Plan

Display of Accounts for the Selected Plan

October 1974

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	A-1
DISCOUNT RATE	A-1
ABBREVIATED ENVIRONMENTAL QUALITY PLAN	A-2
Environmental Concerns	A-2
Objectives	A-3
Plan Formulation	A-4
Environmental Quality Plan	A-5
Technical Assistance	A-5
Nonstructural Measures	A-6
Structural Measures	A-7
Effects and Impacts	A-8
Conservation Land Treatment	A-8
Nonstructural Measures	A-8
Structural Measures	A-9
Explanation of Costs	A-10
Explanation of Implementation	A-11
Minutes of EQ Plan Formulation Meeting	A-12
DISPLAY OF ACCOUNTS FOR THE SELECTED PLAN	A-16

ADDENDUM

LOST RIVER WATERSHED WORK PLAN

Hardy County, West Virginia

October 1974

INTRODUCTION

This addendum was developed in accordance with phase-in procedures agreed to between the Water Resources Council and the USDA, Soil Conservation Service for Level C plans for which field studies, analyses, and evaluations were completed as of October 25, 1973, and which have been formulated in accordance with Senate Document 97 as supplemented and amended, and which are to be transmitted to the OMB between December 31, 1973 and December 31, 1974.

DISCOUNT RATE

The following table shows the project cost and benefits based upon 5-7/8 percent interest rate and current normalized prices. The recreation values used were \$2.25 per user day.

<u>Interest Rate</u>	<u>5-7/8 Percent</u>
Project Cost	\$449,700
Project Benefits	\$628,500
Benefit-Cost Ratio	1.4:1.0

ABBREVIATED ENVIRONMENTAL QUALITY PLAN

Environmental Concerns

Lost River is located in the Eastern Panhandle of West Virginia within a region that is highly regarded for its fish, wildlife, and scenic resources. Hunters and fishermen are attracted to the area from surrounding states and from the eastern metropolitan areas.

The watershed is made up of small rural communities and scattered farms. Population density of the watershed is 11 people per square mile as compared to State density of 77 people per square mile. Land use is 74 percent forest, 17 percent grassland, 8 percent cropland, and 1 percent other.

Data from the U.S. Department of Commerce Climatological Data Bulletins indicate summer temperatures above 100° F are rare, whereas, temperatures in the lower 90's occur frequently. Winter temperatures below 15° F do not occur for long periods, however, temperatures below freezing occur for several days at a time. The average growing season is 147 days from mid-May to late September.

Game resource problems associated with Lost River Watershed are increasing deer population, posted private land, and improper timber harvest practices. Deer populations in certain areas of Hardy County and Lost River Watershed approach (or exceed) range capacities as evidenced by decreased physical growth, high numbers of deer-vehicle collisions, and extensive range and crop damage.

Fishery resources in the watershed have been adversely affected by stream channel disturbances, low summer stream flows, lack of lake waters, and few public access areas.

Several examples of the historical aspects of Lost River can be found in the watershed today. The valley was first settled by pioneer families in the early 1700's. Grants of land in Lost River were first surveyed for Lord Fairfax by George Washington in 1748. The 200-year old Hawse homeplace and 125-year old Woodlawn exist today on land surveyed by Washington. During Revolutionary times, the present Lost River State Park was a summer resort which catered to southerners. Lee's Cabin, which is situated in the park, was once the summer home of Revolutionary General "Lighthorse" Harry Lee and has been nominated for listing in the National Register of Historic Places.

Soils of the watershed are typically low in fertility and many upland farms and fields are too small or steep for efficient use of modern equipment. Typical problems include overgrazing of steep pastures, low forage production due to low fertility and continuous grazing, grazing of forest land, lack of cropland protection, and erosion from farm and forest roads. Approximately 10 acres of critically eroding roadbanks need stabilized. Needed adjustments appear to be within the financial ability of most watershed landowners but assistance is needed through the acceleration of current programs to encourage the establishment of essential conservation practices to meet project objectives.

An area of public interest is the Lost River Sinks. Normal flows on Lost River go underground and emerge approximately 1-1/2 miles further downstream. At the point of emergence it is called Cacapon River.

Objectives

This plan was formulated to enhance environmental quality by the management, conservation, preservation, creation, restoration, and improvement of the quality of certain natural and cultural resources and ecological systems in Lost River Watershed. Objective components specified for plan formulation were:

Manage, protect, and enhance areas of natural beauty in the watershed including forest land, streams, and farmland.

Manage and enhance biological resources of the watershed including terrestrial and aquatic habitat and populations.

Enhance quality of watershed streams by the reduction of sediment and the increase of low stream flows.

Preserve any outstanding archeological, historical, or geological resources in the watershed as defined by the Advisory Council on Historic Preservation.

Maintain and enhance the quality of watershed land by the stabilization of critical areas and reduction of runoff and erosion.

Maintain and enhance natural resources by regulating development within the watershed.

Plan Formulation

The Environmental Protection Agency, U.S. Fish and Wildlife Service, West Virginia Department of Natural Resources, and interested local groups were invited to attend and participate in the abbreviated environmental quality plan formulation meeting. This meeting was held on April 3, 1974, at the Vocational-Technical School in Petersburg, West Virginia. At this meeting the participants discussed environment concerns for the watershed and possible increments of the plan. The minutes of this meeting are appended for reference.

Objectives that were consistent with the intent of the Principles and Standards were specified for plan formulation. During the formulation process, problems, needs, and solutions were discussed for each objective component.

Principal environmental problems and needs identified during plan formulation included: encroachment of people on the flood plain and wildlife habitat, low stream flows, improper channel modifications, improper land use, posting of hunting and fishing areas, lack of fishery resources, overpopulation of deer, and need for land use planning. Other needs discussed concerned the need for determining the status of wildlife species requiring special management and outstanding cultural features in the watershed.

For each problem and component objective identified, potential solutions and actions were discussed. Each solution was evaluated for its acceptability and effectiveness in meeting plan objectives and implementation. Solution measures proposed for environmental quality plan formulation were:

1. Install sediment basins.
2. Install multiple-purpose upstream impoundments.
3. Regulate channel modifications.
4. Stabilize roadbanks, streambanks, and other critical areas.
5. Implement land use regulations.
6. Accelerate the conservation land treatment practices.
7. Endorse a sediment control law.
8. Obtain public easements for fishing access.
9. Regulate deer population through legislation.
10. Public purchase of Lost River Sinks.
11. Determine the status of wildlife species requiring special management.
12. Encourage the formation of landowner hunting cooperatives.
13. Determine the status of cultural and geological resources.
14. Protect Lost River by inclusion in the Wild and Scenic Rivers Act.

Alternate actions to meet objectives were discussed for each proposed measure. It was felt that land use regulations would provide the most environmentally sound solution to future flood plain encroachment and residential and urban developments, because certain floodproofing techniques would detract from the natural beauty, and large impoundments or channel work would adversely affect biological systems. The group decided that small upstream impoundments could provide a combination of low flow augmentation, sediment detention, and public fishing. Since the land treatment phase of the selected plan was developed mainly to satisfy environmental concerns, it was adopted for the abbreviated environmental quality plan.

Environmental Quality Plan

The abbreviated environmental quality plan for Lost River Watershed includes land treatment, technical assistance, nonstructural measures, and structural measures.

Land treatment of the abbreviated environmental quality plan is identical to the land treatment of the selected plan for this watershed.

Technical Assistance: The Soil Conservation Service, through the Potomac Valley Soil Conservation District, would provide technical assistance for detailed planning of needed land treatment measures to interested public groups and units of State and County governments. This assistance would be used to develop inventories and establish criteria for the use of soil, water, fish and wildlife, and recreation resources. Assistance would be provided to develop new resource conservation plans and to revise existing resource conservation plans.

The Service would also provide technical and consultive assistance through the District to install land treatment measures on individual farms. Technical assistance would provide surveys, designs, layout, and construction inspection of conservation practices. Consultive assistance would impart knowledge and understanding of conservation practice standards to be used to install practices.

The Potomac Valley Soil Conservation District would assume a leadership role for installation of planned land treatment measures, and would encourage landowners to practice conservation and become cooperators with the Soil Conservation District. By using demonstration projects, newspaper and magazine articles, radio and television broadcasts, and educational classes in the public schools, the District would stimulate landowners' interest in planning, designing, and installing conservation practices.

The Service would provide information and assistance for the development of wildlife habitat. This assistance would be in the form of existing wildlife inventories for available food sources, existing cover and nesting areas, and recommended practices to improve the habitat. In addition, assistance would be provided for stocking, managing, and operating farm ponds as a fishery resource.

Assistance would be provided by the Service to educate landowners about visual impacts of land treatment measures, and to encourage them to install land treatment measures to enhance visual resources. Also included in the land treatment measures is critical area stabilization for planting 10 acres of roadbank and 15 acres of bare areas in pasture.

The West Virginia Department of Natural Resources, Division of Forestry, will develop forest inventories and make recommendations concerning multiple-use management of all forest resources. This assistance will be provided in cooperation with the U.S. Forest Service.

Posting of private land in the watershed has limited public hunting access. The Soil Conservation Service and the West Virginia Department of Natural Resources will furnish technical assistance for the formation of landowner cooperatives to open private land to hunting.

Nonstructural Measures: Nonstructural measures proposed in this abbreviated environmental quality plan are land purchase, land use regulations, obtaining public easements for access, and erosion and sediment control regulations.

There are 15,800 acres of public forest land in the watershed. About 3,700 acres are located in Lost River State Park and administered by the West Virginia Department of Natural Resources, and 12,100 acres are located in George Washington National Forest. The remaining part of the watershed is owned by private individuals. This plan recommends the purchase of approximately 600 acres of land involving the Lost River Sinks. The plan also recommends the purchase of public easements for about 50 acres of land along Lost River for the purpose of fishing and fishing access.

County-wide land use regulations should be developed for Hardy County to control residential and urban development, especially in flood plain areas. Prior to development, a conservation and sediment control plan, commensurate with the type of development, should be approved and enforced by the County Court. This plan would ensure that good quality environment will be maintained. Guidelines and criteria established in the "Erosion and Sediment Control Handbook for Urban Areas in West Virginia," published by the Soil Conservation Service in 1974, could be followed.

The entire Cacapon River, which includes Lost River, has been identified as having potential under Section 5(d) of the Wild and Scenic Rivers Act. At the present time, however, it enjoys no special protection or status. This plan recommends protection of Lost River by its inclusion in the Wild and Scenic Rivers Act.

Location and status of cultural and geological resources would be surveyed. Where applicable, valuable sites such as Lee's Cabin, should be included in the National Register of Historic Places.

Legislation would be enacted to control deer population through adequate harvest during hunting season.

Status of wildlife species requiring special management in the watershed is unknown. A study would be implemented to identify and properly manage any valuable species.

Structural Measures: Structural measures proposed in this abbreviated environmental quality plan consist of five multiple-purpose (low flow augmentation and sediment) dams, six sediment dams, and stream fish habitat improvement devices.

Five multiple-purpose low flow augmentation and sediment dams would be installed at Site No. 27 on Upper Cove Run, Site No. 23 on Culler Run, Site No. 4 on Kimsey Run, Site No. 16 on Lower Cove Run, and Site No. 10 on Camp Branch. These sites are located as shown on the project map for the selected plan. These dams are planned to be constructed of compacted earth and rock-fill with a design life of 100 years. To construct the dams would require 4,312,000 cubic yards of material. The dam heights would range from 85 feet at Site No. 4 to 117 feet at Site No. 23. Storage would be provided for 1,490 acre-feet of sediment and 12,200 acre-feet of low flow augmentation for fish and wildlife improvement. Flow gates would be installed in each dam to regulate flow releases. A concrete emergency spillway has been planned for Sites 4, 16, and 27 and an earth emergency spillway for Sites 10 and 23.

The six single-purpose sediment dams would be located on small tributaries to Lost River. They are planned for an economic life of 10 years. The sediment dams would range from 15 feet to 40 feet in height and store approximately 53 acre-feet of sediment when full. The sediment dams would provide protection against sediment damage until land stabilization and land treatment measures effectively control erosion at its source. At that time the dams would be reclaimed by cleaning out and applying sound conservation practices and turned over to landowners to be used as recreation or fish and wildlife ponds.

Fish habitat improvement structures are planned for Lost River and some of its tributaries. Concrete structures or rock filled gabions would be used to build low head weirs across the stream. The weirs would cause a small holding pool to form on its upstream side, and where water tumbled over the downstream face of the weirs, a small holding pool would be carved into the channel bottom creating a downstream riffle and improve the fish habitat. Each weir would be keyed into the channel bank and bottom to sufficient depth to keep it from being washed out during high flood flows.

Effects and Impacts

Conservation Land Treatment: Installation of the land treatment measures would establish and maintain adequate vegetative cover throughout the entire watershed, bring about better land use, reduce erosion and sedimentation, improve fish and wildlife habitat, and enhance visual qualities of the watershed.

Establishment of good vegetative cover throughout the watershed would reduce the average watershed erosion rate by 10 percent. This would reduce the amount of soil movement by 35,136 tons per year and would prevent 2,810 tons of sediment per year from leaving the watershed. Keeping sediment out of the streams would improve fish habitat and reduce the need for emergency channel cleanout work.

Nonstructural Measures: Purchase of 600 acres of watershed land would provide public access and preservation for the Lost River Sinks area. Purchase of easements for 50 acres of land along Lost River for fishing and fishing access would provide stream fishing for most of Lost River.

Implementation of land use regulations would discourage unplanned residential development. Future residential development below the 100-year frequency flood would be eliminated. This would preserve undeveloped flood plains for wildlife habitat.

Implementation of sediment control legislation would provide an effective means of controlling sediment from developments that now are unrestricted. This program would reduce sediment from construction sites and disturbed areas about 85 percent. Also included in this legislation would be regulations governing stream channel modification.

Structural Measures: Construction of the five multiple-purpose dams, six sediment dams, and fish habitat improvement devices would improve environmental quality by enhancing fish and wildlife habitat, reducing sediment, and improving visual qualities of the area.

The five multiple-purpose dams would store 1,490 acre-feet of sediment and 12,200 acre-feet of low flow augmentation water. Trapping this amount of sediment (approximately 2,235,000 tons) would reduce sediment deposition and stream turbidity. This would improve the fish and other aquatic habitat, and reduce the need for annual channel cleanout work. This cleanout work results in disturbance of a large portion of the fish habitat. Releasing water during periods of low stream flow would improve fish and wildlife habitat in 36 miles of stream. Low flow releases would average 46 cubic feet per second over a 3-month period. Forty-six cubic feet per second is optimum stream flow for fish and wildlife propagation in Lost River. Installation of the six sediment dams would trap an additional 79,500 tons of sediment.

Construction of the structural measures would cause a temporary increase in turbidity of stream water. This would result primarily from removal of the vegetative cover and from work in or near the streams. Sediment concentrations at the mouth of the watershed will increase about 0.18 percent during construction. Erosion control measures and techniques would be implemented during construction in order to minimize erosion. The structural measures would inundate about 560 acres of land. Most of this land is presently small game habitat (rabbits, raccoons, skunks, etc.). Revegetation of structural measures will be accomplished using adapted grasses and plants that would provide food and habitat for this type of wildlife.

Installation of fish habitat improvement devices would create 8 acres of new fish habitat and improve existing fish habitat. Holding pools with about 0.1 acre surface area, averaging 1.5 feet deep, would be formed above each weir. Pools below the weir would be about 0.01 acre in size with an average depth of 3 feet. Riffles would form downstream from the pools below the weir.

Installation of the five multiple-purpose dams would provide 460 acres of flat water fishing not now available in the watershed. Impounded waters would be suitable for spring trout stocking and a largemouth bass-bluegill fishery. The impoundments and fish improvement devices would be managed by the West Virginia Department of Natural Resources. The low flow augmentation and sediment dams would inundate approximately 3.2 miles of free flowing streams which are a fishery and aesthetic resource.

Explanation of Costs

Costs of applying land treatment measures are based on normal costs experienced in installing land treatment practices during the period 1964 to 1974 in West Virginia. Costs of installing forest land treatment measures were furnished by the U.S. Forest Service based on recent costs experienced in installing such measures on private forest land. Total cost of installing the land treatment measures is \$470,500.

Costs of providing technical assistance for installing land treatment measures would be furnished by the Soil Conservation Service and the U.S. Forest Service. These costs were based on actual expenditures and accomplishments over the last 10 years. An analysis of costs versus accomplishments was made to determine unit costs for technical assistance. Total costs of providing technical assistance to install land treatment measures is estimated at \$135,900.

Costs of installing roadbank stabilization measures would be shared on a division of work basis between the Potomac Valley Soil Conservation District and the Service. The District would provide labor (5-man work crew) and equipment (dump truck, hydro-seeder, and small dozer) necessary to accomplish the work with the Service providing land treatment materials (seed, fertilizer, lime, and mulch). Estimated costs of roadbank stabilization is \$7,500.

Costs for developing and enforcing land use and erosion and sediment control regulations would be provided by the Hardy County Court. Total estimated cost of developing, administering, and enforcing these regulations is estimated at \$20,000 per year.

The Soil Conservation Service would provide information concerning flood hazard areas, elevations of various frequency floods, and water flow capacities to be used by the County Court in developing land use regulations. This cost is estimated to be about \$3,500.

Estimated costs of installing the six sediment dams is \$1,002,000. This includes costs for construction of the dams (\$832,000), costs for land rights (\$60,000), and costs for engineering and administrative services (\$110,000). Costs of installing the five multiple-purpose dams is \$8,870,000, of which \$7,430,000 is for construction, \$368,600 for land rights and \$1,071,400 for engineering and administrative services.

The total cost of the abbreviated environmental quality plan would be approximately \$10,500,000.

Explanation of Implementation

Land treatment measures (both the "on-going" and "accelerated") would be installed by individual landowners on private land. The Potomac Valley Soil Conservation District is responsible for coordinating the on-going land treatment practices throughout the watershed in accordance with their long range plans. The District would also assume leadership for installation of accelerated land treatment planned for this project.

The West Virginia Department of Natural Resources, Division of Forestry, in cooperation with the U.S. Forest Service, would make forest inventories and develop recommendations concerning multiple-use management of all forest resources. The Forest Service would install planned land treatment practices on the Monongahela National Forest with their own resources.

The Potomac Valley Soil Conservation District would be responsible for stabilizing approximately 10 acres of critical eroding roadbanks. This work will be coordinated with the West Virginia Department of Highways.

The cost of five multiple-purpose dams, six sediment dams and the fish habitat improvement devices would be borne by the local sponsors and supplemented by State funds. Technical assistance required could be furnished by the local, State, and Federal agencies through the use of "on-going" program funds with PL-534 funds for necessary accelerations.

The costs for land use regulations and erosion and sediment control regulations under current authorities would be a local cost to be paid for by the sponsors and flood plain residents.

The purchase of about 600 acres of land involving the Lost River Sinks and 50 acres of land for fishing and fishing access should be financed and managed by the West Virginia Department of Natural Resources.

LOST RIVER WATERSHED

Abbreviated Environmental Quality (E.Q.) Plan

Minutes of Planning Meeting

A meeting to formulate an abbreviated environmental quality plan for Lost River Watershed was held at the Vo-Tech School in Petersburg, West Virginia on April 3, 1974. Attending and participating in the meeting were:

Terry G. Fairbanks	SCS	Engineer, RB-WS Planning Staff
Doug Harman	SCS	Hydrologist, RB-WS Planning Staff
Willis Gainer	SCS	Biologist, RB-WS Planning Staff
Thomas Crebbs	SCS	State Biologist
Harold Kessel	SCS	RC&D Coordinator
Dick Allen	SCS	Project Engineer
Orland Parks, Jr.	SCS	District Conservationist
Robert Morris	SCS	Area Biologist
Bill Santonas	DNR	Supr. Game & Fish Planning
Jerry Lewis	DNR	District Fish Biologist
Gary Strawn	DNR	District Game Biologist

Terry Fairbanks, discussion leader, opened the meeting at 10:00 a.m., with the introduction of the participants. Terry briefly acquainted the group with the recently issued guidelines of the Water Resources Council, Principles and Standards. He explained that the new guidelines became effective on October 25, 1973, but that projects whose plans had been essentially formulated prior to that date, such as Lost River, would need to comply with phase-in procedures. As a part of these procedures, an abbreviated Environmental Quality (E.Q.) Plan would need to be formulated for each applicable watershed.

The group considered the overall environmental objectives of an E.Q. Plan and discussed the best approach to plan formulation. It was decided to discuss problems, needs, and solutions under the components specified in the Principles and Standards guidelines. The following summarizes the discussion to formulate the abbreviated E.Q. Plan for Lost River Watershed:

I. Areas of Natural Beauty

A. Open and Green Space

The group felt that there were presently no problems with maintenance of open and green space in the watershed due to the lack of urban development and the present abundance of such space. However, due to the recreation development potential within the watershed, it was thought that human encroachment may present minor problems, if not regulated.

B. Wild and Scenic Rivers

Problem: The entire Cacapon River, which includes Lost River, has been identified as having wild and scenic potential under Section 5(d) of the Wild and Scenic Rivers Act. At present time, however, it enjoys no special protection or status.

Plan Solution: Protect Lost River by inclusion in the Wild and Scenic Rivers Act.

C. Water Resources

1. Problem: Fluctuating stream flows and sediment loads detract from the scenic values of Lost River Watershed.

Plan Solution: Reduce erosion and sediment through the conservation land treatment program. Install sediment basins, where needed, to contain sediment loads. Storage of water in upstream impoundments to maintain flows during critically low periods.

2. Problem: Improper stream modifications have destroyed natural scenic values of several stream reaches in the watershed

Plan Solution: Propose legislation to regulate future channel modifications.

D. Mountains and Wilderness Areas

(Not applicable by definition.)

II. Quality of Land, Water and Air

A. Land

Problem: Improper land use management has deteriorated land quality in the watershed.

Plan Solution: Develop a proper land use management program including the following: (a) land treatment program, (b) roadbank stabilization, (c) streambank stabilization, (d) critical area stabilization.

Endorse a Sediment Control Law to protect the quality of land and water in the watershed.

B. Water

Water quality was not considered a problem in the watershed as long as existing State standards are met.

C. Air

There are no air quality problems within the watershed, but enforcement of the Clean Air Act is needed to control outside pollution sources that might affect the watershed.

III. Biological Resources

A. Terrestrial Ecosystems

1. Problem: Deer population approach (or exceed) range capacities in the watershed.

Plan Solution: DNR game biologists recommend population control through adequate harvest during hunting seasons.

2. Problem: Turkey habitat is being diminished because of encroachment and improper distribution of human populations.

Plan Solution: Land use planning and regulations to control population distribution. Public ownership (or lease) of valuable habitat areas.

3. Problem: Status of wildlife species requiring special management in the watershed is unknown.

Plan Solution: Implement a study to identify and properly manage any threatened species.

4. Problem: Posting of private land in the watershed has limited public hunting access.

Plan Solution: Encourage the formation of landowner cooperatives to open private land to hunting.

B. Aquatic Ecosystems

1. Problem: Improper stream modifications have adversely affected aquatic life in several stream reaches in the watershed.

Plan Solution: Propose legislation to regulate future channel modifications.

2. Problem: Fishery resources are limited by low stream flows during summer months and lack of habitat on smaller streams.

Plan Solution: Storage of water in upstream impoundments to increase flows during summer months. Install fish-stream improvement devices to increase fish habitat.

3. Problem: Fishery resources are restricted by low water fertility.

Plan Solution: Improve fertility through proper land use and conservation land treatment.

4. Problem: Fishing access has been limited by posting of private land along streams.

Plan Solution: Obtain public easements at selected locations along the streams.

IV. Archeological, Historical, and Geological Resources

1. Problem: Value of status of archeological, historical, or geological resources is unknown.

Need: Locate and preserve points of interest or value.

Plan Solution: Public purchase or easement of outstanding sites. It was proposed that Lost River Sinks area be preserved by purchase or easement.

Where applicable, valuable sites such as Lee's Cabin should be included in the National Register of Historic Places.

Abbreviated E.Q. Plan Formulation

The plan solution measures, amounts, and costs were discussed by the group. It was determined that more information was needed before specific amounts or costs of the plan could be specified. Assignments were made to gather more information: (1) Fairbanks would determine the number of sediment basins needed and their costs, (2) Morris and Lewis would determine the amount of flow needed to maintain aesthetic and aquatic stream levels, (3) Crebbs and Gainer would determine the number of fishstream improvement devices and cost, and (4) Harman would determine the number of impoundments needed for flow regulation and cost.

After amounts and costs are determined, a draft abbreviated E.Q. Plan will be formulated and sent to the participants for review.

LOST RIVER SUBWATERSHED, WEST VIRGINIA

Selected Plan

NATIONAL ECONOMIC DEVELOPMENT ACCOUNT (Dollars) 1/

<u>Components</u>		<u>Measures of Effects</u>	<u>Components</u>	<u>Measures of Effects</u>
Beneficial Effects:			Adverse Effects:	
A. The value to users of increased outputs of goods & services			A. The value of resources required for a plan	
1. Flood prevention		246,000	1. Floodwater retarding structure & a multiple-purpose reservoir, & and recreational facilities.	
2. Recreation		237,900		
3. Utilization of unemployed & underemployed labor				
	Project Construction & OM&R	97,200	Project installation (Structural measures)	354,800
			Project administration	45,100
			OM&R	32,300
Total Beneficial Effects		581,100	Total Adverse Effects	432,200
			Net Beneficial Effects	148,900

A-16

1/ Average Annual Dollars, 1973 Price Base.

LOST RIVER SUBWATERSHED, WEST VIRGINIA

Selected Plan

REGIONAL DEVELOPMENT ACCOUNT (Dollars) 1/

Measures of Effects		Measures of Effects	
West Virginia	Rest of Nation	West Virginia	Rest of Nation
Components		Components	
Beneficial Effects:			
A. Income:			
1. The value of increased output of goods & services to users residing in the region.		1. The value of resources contributed from within the region to achieve the outputs.	
(a) Flood prevention	246,000	(a) Floodwater retarding structures & and multipurpose reservoir, & recreational facilities.	
(b) Recreation	237,900		
(c) Utilization of regional unemployed or underemployed labor			
Project Construction & OM&R	97,200	Project Installation (structural measures)	51,600
Secondary	46,600	Project Administration	1,700
		OM&R	32,300
Total Beneficial Effects	627,700		
		Total Adverse Effects	85,600
		Net Beneficial Effects	542,100

A-17

1/ Average Annual Dollars, 1973 Price Base.

Selected Plan

REGIONAL DEVELOPMENT ACCOUNT

Measures of Effect		Measures of Effect	
West Virginia	Rest of Nation	West Virginia	Rest of Nation
Beneficial Effects:		Adverse Effects:	
B. Employment:		B. Employment:	
1. Increase in number & type of jobs.		1. Decrease in number & type of jobs.	None
(a) Employment for project construction	24 skilled jobs for 8 yrs. or 93 man yrs.		
	8 semi-skilled jobs for 8 yrs. or 64 man yrs.		
(b) Employment for project OM&R	5 permanent semi-skilled jobs.	Net Beneficial Effects	24 skilled jobs for 8 yrs.
Total Beneficial Effects	24 skilled jobs for 8 yrs.		8 semi-skilled jobs for 8 yrs.
	8 semi-skilled jobs for 8 yrs.		5 permanent semi-skilled jobs.
	5 permanent semi-skilled jobs.		

LOST RIVER SUBWATERSHED, WEST VIRGINIA

Selected Plan

REGIONAL DEVELOPMENT ACCOUNT

<u>Components</u>	<u>Measures of Effects</u>	
	<u>West Virginia</u>	<u>Rest of Nation</u>
Beneficial Effects:		
C. Population Distribution	Creates a net of 24 skilled, 8 semi-skilled jobs for 8 yrs., & 5 permanent semi-skilled jobs annually in an area which has experienced a 4.9 percent reduction of population in the last 10 years. New jobs will help alleviate metropolitan urbanization.	--
D. Regional Economic Base and Stability	Provides 105,750 visitor-days of water based recreation in an area that is less than 100 air miles from 6 standard metropolitan statistical areas within a 7-hr. drive of 9 million people. Provides for labor payroll of \$1,603,300 for construction workers (\$200,400 annually for 8 yr. period). Provides for 5 permanent semi-skilled jobs essential for project OM&R.	

LOST RIVER SUBWATERSHED, WEST VIRGINIA

Selected Plan

ENVIRONMENTAL QUALITY ACCOUNT

Components

Measures of Effects

Beneficial and Adverse Effects:

A. Areas of Natural Beauty

1. Project output will make available regional funds and resources that can be used to enhance the physical appearance of 94,750 acres on 337 farms. Application of conservation land treatment measures will reduce erosion and increase production on grassland, cropland, and forest land.
2. Create 143 surface acres of impounded water, including 50 surface acres for recreation.
3. Inundate 735 acres of meadow, pasture, and forest along 2.4 miles of streams.
4. Provide 225 acres of open and green space in association with recreation facilities.
5. Disruption in tranquility of rural environment by 105,750 recreation visitor-days annually.
6. Temporarily disrupt aesthetic values during construction periods.

LOST RIVER SUBWATERSHED, WEST VIRGINIA

Selected Plan

ENVIRONMENTAL QUALITY ACCOUNT

<u>Components</u>	<u>Measures of Effect</u>
B. Quality Consideration of Water, Land and Air Resources	<ol style="list-style-type: none">1. Reduce future erosion and conserve soil moisture on 94,750 acres of watershed lands.2. Improve water quality of Lost River and downstream rivers by reducing the sediment yield from the watershed by 12,300 tons annually.3. Temporarily increase sediment concentrations, air, and noise pollution during construction periods.4. Change flood plain land use by providing 5-year frequency flood protection to 476 acres.5. Improve use of watershed lands by managing them within their capabilities.
C. Biological Resources and Ecosystems	<ol style="list-style-type: none">1. Create 167 acres of warm water suitable for fishing and waterfowl resting.2. Enhances wildlife habitat on 94,750 acres of watershed land.3. Improve fish habitat by reducing sediment concentration levels of Lost River.4. Improve wildlife habitat on 152 acres of land surrounding proposed structures.5. Inundate 2.4 miles of natural stream ecosystems.

LOST RIVER SUBWATERSHED, WEST VIRGINIA

Selected Plan

ENVIRONMENTAL QUALITY ACCOUNT

<u>Components</u>	<u>Measures of Effect</u>
C. Biological Resources and Ecosystems. (Continued)	6. Temporarily reduce fish food production by increasing turbidity during construction periods.
	7. Inundate 168 acres of terrestrial wildlife habitat.
D. Geological, Archeological, and Historical Resources	- - - - -
E. Irreversible or Irretrievable Commitments.	Conversion of 735 acres of agricultural land and 2.4 miles of stream to reservoir pools.

LOST RIVER SUBWATERSHED, WEST VIRGINIA

Selected Plan

SOCIAL WELL-BEING ACCOUNT

ComponentsMeasures of Effect

Beneficial and Adverse Effects:

A. Real Income Distribution

Not Available

B. Life, Health, and Safety

Provides 20 percent level of flood protection to 476 acres and 1 percent level of flood protection to first floors of 23 dwellings and 9 commercial establishments.

C. Recreational Opportunities

Creates 105,750 recreational visitor day activities.

Activities:	Visitor Days
Picnicking	43,000
Camping	14,000
Swimming	45,000
Fishing	<u>3,750</u>
TOTAL	105,750

WATERSHED WORK PLAN

LOST RIVER SUBWATERSHED

OF THE

POTOMAC RIVER WATERSHED

Hardy County, West Virginia

Prepared under the Authority of the
Flood Control Act, P.L. 534,
December 22, 1944

Prepared by: County Court of Hardy County
Hardy County Parks & Recreation
Commission
Potomac Valley Soil Conservation
District of the State of West Virginia

With Assistance By:

United States Department of Agriculture, Soil Conservation Service
United States Department of Agriculture, Forest Service

October 1974

WATERSHED WORK PLAN AGREEMENT

between the

County Court of Hardy County
Potomac Valley Soil Conservation District

of the State of West Virginia

(hereinafter referred to as the Sponsoring Local Organizations)

and the

Soil Conservation Service
United States Department of Agriculture

Whereas, application has heretofore been made to the State Conservationist by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Lost River Watershed, State of West Virginia, under the authority of P.L. 534 approved December 22, 1944, (49 Stat. 1570); and

Whereas, the responsibility for administration of this Act has been assigned by the Secretary of Agriculture to the Soil Conservation Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service, a mutually satisfactory plan for works of improvement for the Lost River Watershed, State of West Virginia, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about eight years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire such land rights as will be needed in connection with the works of improvement. The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

b.

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations</u> (Percent)	<u>Service</u> (Percent)	<u>Estimated Land Rights Costs</u> (Dollars)
Multiple-purpose Structure No. 16 and Recreation Facilities			
Payment to landowners for about 225 acres	50.0	50.0	40,000
Cost of alteration or modification of improvements*	50.0	50.0	19,800
Legal fees, survey costs, flowage ease- ments, and other	100.0	0	4,800
All Other Structural Measures	100.0	0	494,900

*Including necessary engineering services, construction, and additional land costs.

The Sponsoring Local Organizations agree that all land acquired or improved with P.L. 534 financial or credit assistance will not be sold or otherwise disposed of for the evaluated life of the project, except to a public agency which will continue to maintain and operate the development in accordance with the Operation and Maintenance Agreement.

2. The Sponsoring Local Organizations will provide relocation assistance advisory services, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The real property acquisition policies contained in said Act shall be followed in all cases.

The cost of relocation payments will be shared by the Sponsoring Local Organizations and the Service as follows:

<u>Item</u>	<u>Sponsoring Local Organizations</u> (Percent)	<u>Service</u> (Percent)	<u>Estimated Relocation Payment Costs</u> (Dollars)
Relocation Payments	16.9	83.1	86,300

c.

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to the State law as may be needed in the installation and operation of works of improvement.
4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations</u> (Percent)	<u>Service</u> (Percent)	<u>Estimated Costs</u> (Dollars)
Multiple-purpose Structure No. 16	7.5	92.5	1,416,600
Recreation Facilities	50.0	50.0	487,000
Floodwater Retarding Structures	0	100.0	3,228,500

5. The Sponsoring Local Organizations and the Service will perform the revegetation of approximately 10 acres of critically eroding areas on roadbanks on a division of work basis. The Service will provide the materials with the Sponsoring Local Organizations providing the labor and equipment for installation.
6. The percentages of the engineering costs to be borne by the Sponsoring Local Organizations and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organizations</u> (Percent)	<u>Service</u> (Percent)	<u>Estimated Costs</u> (Dollars)
Multiple-purpose Structure No. 16	0	100.0	141,700
Recreation Facilities (A and E Contract)	50.0	50.0	39,000
Floodwater Retarding Structures	0	100.0	322,800

7. The Sponsoring Local Organizations and the Service will each bear the cost of Project Administration which it incurs, estimated to be \$30,200 and \$768,200, respectively.
8. The Sponsoring Local Organizations will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

d.

9. The Sponsoring Local Organizations will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
10. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
11. The Sponsoring Local Organizations will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work of arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
12. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.
13. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose. The fulfillment of obligations by the Potomac Valley Soil Conservation District is contingent on satisfactory arrangement being made with the Department of Highways and public utilities concerning highway and utility relocations and on the availability of funds.

A separate agreement will be entered into between the Soil Conservation Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

14. The watershed work plan may be amended or revised, and the agreement may be modified or terminated, only by mutual agreement of the parties hereto.
15. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
16. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964 and the resolutions of the Secretary of Agriculture (7 C. F.R. Sec. 15.11-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

e.

17. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

COUNTY COURT OF HARDY COUNTY

By J. Winston Teets

Title President

Address Lost River, W. Va. 26811

Zip Code

Date October 10, 1974

The signing of this agreement was authorized by a resolution of the governing body of the County Court of Hardy County adopted at a meeting held on 10-10-74.

Sue K. Halterman

Clerk, County Court of Hardy County

Address Moorefield, W. Va. 26836

Zip Code

Date October 10, 1974

POTOMAC VALLEY SOIL CONSERVATION DISTRICT

By W. C. Taylor

Title Chairman

Address Petersburg, W. Va. 26847

Zip Code

Date 10-10-74

The signing of this agreement was authorized by a resolution of the governing body of the Potomac Valley Soil Conservation District adopted at a meeting held on 10-2-74.

R. L. Baker

Secretary, Potomac Valley Soil Conservation District

Address Baker, W. Va. 26801

Zip Code

Date October 10, 1974

f.

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
UNITED STATES DEPARTMENT OF AGRICULTURE

By James S. Bennett
State Conservationist

Date October 21, 1974

TABLE OF CONTENTS

	<u>Page</u>
SUMMARY OF PLAN	1
DESCRIPTION OF THE WATERSHED	3
Physical Data	3
Economic Data	5
Land Treatment Data	6
Fish and Wildlife Resource Data	7
Recreation Resource Data	8
WATERSHED PROBLEMS	9
Floodwater Damage	9
Sediment Damage	11
Erosion Damage	14
Problems Relating to Water Management	14
PROJECTS OF OTHER AGENCIES	15
PROJECT FORMULATION	15
Alternatives	16
Nonstructural	16
Land Treatment Alone	16
Land Treatment, Floodproofing and Flood Insurance	17
Structural	18
Land Treatment and Recreation Only	18
Land Treatment, Stream Channel Modification and Diking	19
Land Treatment, Floodwater Retarding Structures and Recreation	19
Flood Plain Purchase	20
No Project	20
Reasons for Selecting the Planned Project	21
WORKS OF IMPROVEMENT TO BE INSTALLED	22
Land Treatment	22
Structural Measures	23
Recreation Facilities	29
EXPLANATION OF INSTALLATION COSTS	31
Land Treatment	31
Structural Measures	31
EFFECTS OF WORKS OF IMPROVEMENT	33
PROJECT BENEFITS	36
COMPARISON OF BENEFITS AND COSTS	37

TABLE OF CONTENTS (Cont'd.)

	<u>Page</u>
PROJECT INSTALLATION	37
Land Treatment	38
Structural Measures	38
FINANCING PROJECT INSTALLATION	40
Land Treatment	40
Structural Measures	41
PROVISIONS FOR OPERATION AND MAINTENANCE	41
Land Treatment	41
Structural Measures	42
TABLES	45
Table 1 - Estimated Project Installation Cost	45
Table 1A - Status of Watershed Works of Improvement	46
Table 2 - Estimated Structural Cost Distribution	47
Table 2A - Cost Allocation and Cost Sharing Summary	48
Table 2B - Recreation Facilities - Estimated Construction Costs	49
Table 3 - Structure Data	52
Table 4 - Annual Cost	53
Table 5 - Estimated Average Annual Flood Damage Reduction Benefits	54
Table 6 - Comparison of Benefits and Costs for Structural Measures	55
INVESTIGATIONS AND ANALYSES	56
Land Treatment	56
Economic Investigations	57
Engineering Investigations	58
Hydrologic and Hydraulic Investigations	60
Geologic Investigations	61
Fish and Wildlife	62
Recreation	63
Archeological, Historical, and Scientific Investigations	63
URBAN FLOOD PLAIN MAP	
RECREATIONAL DEVELOPMENT MAP	
PROJECT MAP	

WATERSHED WORK PLAN

LOST RIVER SUBWATERSHED OF THE POTOMAC RIVER

Hardy County, West Virginia

October 1974

SUMMARY OF PLAN

Lost River Subwatershed of the Potomac River is located in Hardy County, West Virginia, and has a drainage area of 117,200 acres. Located in the subwatershed are the small unincorporated towns of Needmore, Baker, Lost River, Lost City and Mathias. Wardensville, the second largest town in Hardy County with a population of about 300, is located just beyond the lower boundary of the watershed. Harrisonburg, Virginia, is the nearest city and is about 30 miles south of the watershed boundary.

Sponsoring Local Organizations for the project are the Potomac Valley Soil Conservation District and the Hardy County Court.

Frequent flooding and sediment damage to agricultural lands and improvements is the primary problem in the watershed and amounts to an estimated \$91,900 annually. Some businesses, residences, camps, roads, bridges and utilities also receive flood and sediment damage estimated to be \$60,000 annually. The influx of people from outside areas, especially the east coast, is creating recreational demands on this area. A need exists for more developed water-based recreation to meet the demand. A need also exists in this area for a year-round fishery. Streamflow in Lost River becomes too low in the late summer and fall months for productive fishing. The most serious erosion in the subwatershed takes place on steep overgrazed pastures, streambanks, and recently constructed logging roads. There is also some roadbank erosion occurring throughout the watershed.

Works of improvement proposed include land treatment and structural measures. Land treatment measures are planned for 94,750 acres of watershed lands. This amount includes 1,400 acres of cropland, 7,000 acres of grassland, 86,300 acres of forest land, 25 acres of miscellaneous land, and 25 acres of critical area treatment. Structural measures will consist of four single-purpose floodwater retarding structures and one multiple-purpose structure is located on Lower Cove Run, with the 50-acre recreation lake being sponsored by the Hardy County Court and Parks and Recreation Commission. A recreation development consisting of facilities for fishing, hiking, camping, swimming, and picnicking is planned around the lake. All proposed works of improvement will help meet and are consistent with the long-range plan and objectives of the Potomac Valley Soil Conservation District.

Total estimated installation cost of the land treatment measures is \$470,500. Of this amount, \$142,000 will be provided from P.L. 534 funds and \$328,500 will come from other sources. Included in the P.L. 534 funds are \$25,200 for additional soil surveys, \$96,900 for accelerated technical assistance and \$19,900 for application assistance. Other funds include \$13,800 for technical assistance, \$71,700 for fire and pest control on forest land, and \$243,000 for application of conservation practices. Structural measures will cost an estimated \$7,079,800, with \$6,136,600 being paid by P.L. 534 funds and \$943,200 by other sources. Total cost of the project is estimated to be \$7,550,300, with \$6,278,600 being a P.L. 534 cost and \$1,271,700 being a cost to other funds.

The Hardy County Court and Parks and Recreation Commission will be responsible for obtaining land rights and providing for relocation assistance advisory services for the multiple-purpose structure and recreational development. The Potomac Valley Soil Conservation District, with the assistance of the Lost River Watershed Association, will be responsible for obtaining land rights and providing relocation assistance advisory services for the four flood prevention structures. The District and Commission have the right of eminent domain and are willing to use this authority, if necessary.

Soil Conservation Service will administer the construction contracts for structural measures and provide engineering services for all structural measures except the recreation facilities at Structure No. 16. These engineering services will be provided by an approved consultant and the cost shared equally between the Soil Conservation Service and the Hardy County Court and Parks and Recreation Commission.

Land treatment measures will be installed, operated, and maintained by individual landowners on private land under cooperative agreements with the Potomac Valley Soil Conservation District and by the U.S. Forest Service on National Forest Land. The District will be responsible for operation and maintenance of the four single-purpose structures at an estimated annual cost of \$2,100. Structure No. 16 and the recreation facilities around the lake will be operated and maintained by the Hardy County Parks and Recreation Commission at an estimated cost of \$30,200 annually.

Installation of the planned works of improvement will provide a minimum of 5-year level flood protection to agricultural lands. Planned land treatment measures will adequately treat an additional 22,255 acres of watershed land. These measures will include vegetative and simple engineering practices, which will reduce runoff and erosion and improve soil, water, vegetative, and wildlife resources. Floodwater retarding structures have a total flood storage capacity of 14,330 acre-feet and will control about 35 percent of the watershed drainage area. The estimated average annual flood damages to crops, pastures and other agricultural improvements will be reduced by about 88 percent. The project will also provide an acceptable level of flood and sediment protection to residences, businesses, camps, roads, bridges and utilities. Considerable downstream flooding reduction and sediment damage reduction will be realized from this project. Flooding levels will be reduced in the Upper Cacapon River flood plain, which extends from Wardensville, West Virginia, to the confluence of North River below U.S. Route 50. Sediment deposition will be reduced on downstream

areas of the Potomac Basin. The recreation development planned at Structure No. 16 will help satisfy the need for developed water-based recreation and a year-round fishery.

Estimated average annual benefits resulting from installation of structural measures will be \$526,800. Average annual cost of installing, operating, and maintaining these measures is \$423,500, resulting in a benefit-cost ratio of 1.2:1.

DESCRIPTION OF THE WATERSHED

Physical Data

Lost River Subwatershed is located in the eastern panhandle of West Virginia along the Virginia border. Its drainage area of 183 square miles is confined to Hardy County, West Virginia. It includes all the drainage area of Lost River from its headwaters to its junction with Trout Run just west of Wardensville.

There are no incorporated towns in the subwatershed. There are five small towns or villages: Needmore, Baker, Lost River, Lost City, and Mathias. The nearest cities are Harrisonburg and Winchester, Virginia. Harrisonburg is about 30 miles south of the watershed boundary and is more easily reached by area residents.

The topography is characterized by nearly parallel ridges and valleys. Major streams flow northeast with tributaries entering at near 90° angles forming a trellis drainage pattern. Elevations range from a high of about 3,300 feet on North Mountain to 1,000 feet at the mouth of the watershed.

Bedrock in the area consists of sandstone, shale, and limestone of the Carboniferous, Devonian, Silurian, and Ordovician Periods.

There are no major oil or gas fields, although gas is produced from scattered wells in the Lost River gas fields in the central part of the watershed and large transmission lines cross the areas. The U.S. Department of Interior reports that, "Wells in this field and in two nearby fields found gas in structure traps at about 8,000 feet deep in the Oriskany formation. The 25,000 feet of sedimentary rocks, and very possibly 35,000 to 40,000 feet with repeated thrust faulting, have good possibilities for deeper structural and stratigraphic trap deposits. Although some earlier seismic work and wide-spaced drilling has been done, the area needs to be tested by newer seismic techniques and additional holes." There are no minable coals or metallic ores with potential for economic development.

Soils in the watershed are on alluvial bottoms, terraces, colluvial footslopes and residual uplands. Alluvial soils have developed from recent stream sediments washed from upland areas and are composed of materials from shale, sandstone and limestone bedrock. The most common alluvial soils are Pope, Philo, Atkins, Huntington, Lindsides, Dunning and Melvin. Terrace soils are located on relatively flat benches above the present valley floor and are composed of sediments washed from upstream areas. Terrace areas have been formed by the erosion process of the valley floor and are mainly different from the alluvial soils by having better developed profiles and by being higher on the landscape. Common terrace soils present in this area are Monongahela, Allegheny, Tygart, Purdy and Blago.

Colluvial and residual soils are different in this watershed on each side of the valley mainly due to the bedrock formations on the west being acid while those on the east are either limestone or lime containing shales or sandstone. Colluvial soils are developed from material moved from adjacent uplands and are usually deep and subject to slipping on the steeper slopes. Common colluvial soils on the west side of the basin are Ernest, Laidig and Buchanan. On the east side, the common soils on the colluvial footslopes are Laidig, Murrill, Clarksburg, Brookside, Buchanan and Ernest.

Residual soils are formed in place from the parent material present. On the west side of Lost River, common residual soils are Lehew, Berks, Dekalb, Calvin and Weikert. On the east side, the most common soils of the residual areas are Dekalb, Corydon, Litz, Lehew, Edom, Berks and Schaffnaker. Complex soil patterns are common because of the steeply folded bedrock.

Lost River heads in the southern end of Hardy County along the West Virginia-Virginia border. It flows northeast for about 18 miles through a relatively straight valley. The river then enters a rugged area for about 5 miles to a point along Sandy Ridge. In this vicinity, Lost River sinks into a cavernous area in the Helderburg Limestone. It emerges about 1.5 miles to the northeast and is then called the Cacapon River. Only during periods of low flow does the river sink completely. Flood flows follow the defined surface channel and flood plain.

The entire Cacapon River, which includes Lost River, has been identified as having wild and scenic river potential under Section 5(d) of the Wild and Scenic River Act. At the present time, however, it enjoys no special protection or status.

There are no natural or artificial lakes located in the subwatershed except for numerous farm ponds. Trout Pond, the only natural lake in West Virginia, and Rock Cliff Lake are approximately 2 miles from the watershed drainage boundary. Warden Lake is located approximately 4 miles north of the subwatershed boundary. Principal water use is for domestic purposes and comes from wells, springs, ponds and cisterns.

The climate is moderate with few extremes in summer or winter. Temperatures rarely exceed 90°F or stay below freezing for prolonged periods. Average annual rainfall is 35 inches and is well distributed throughout the year. The growing season is about 135 days and normally extends from mid-May to late September.

The area has a good network of primary and secondary roads. West Virginia Route 259 parallels Lost River and bisects the watershed in a northeast-southwest direction. West Virginia Route 55 crosses the northern end of the watershed in an east-west direction. There are no railroads or airports.

Approximately 24,000 acres of the subwatershed are inside the proclamation boundary of the George Washington National Forest with about half this acreage actually in national forest ownership. There is public access to this area, but no recreational developments in that portion drained by Lost River.

Lost River is located in that part of West Virginia sometimes called the Potomac Highlands. It has a reputation for good hunting, fishing, clean air and water and magnificent scenery.

Investigations conducted by the West Virginia Economic and Geologic Survey did not disclose any archeological, historical, or unique scenic areas in the Lost River Watershed that will be affected by the dams or impoundments. A review of the National Register of Historic Places was made and none of the listings will be affected by the project.

Economic Data

Appalachian Regional data as of 1967 indicates that the most significant industry in Hardy County, in terms of earnings, is business services and public services with manufacturing ranking second. Approximate distribution of earnings by broad industrial sectors is as follows:

Business and Public Services	40 percent
Manufacturing	28 percent
Trade	15 percent
Farming	9 percent
Utilities	4 percent
Construction	3 percent
All other	1 percent

In 1969, there were 607 farms with an average size of 289 acres. About 5.4 percent of the farm operators are tenants.

The major agricultural enterprise is broiler production. In 1969, sales from poultry and poultry products amounted to about 65 percent of the value of all agricultural products.

Hunting and fishing provide a seasonal boost to the economy. In 1969, income from hunting, fishing and other recreational privileges amounted to \$9,700. These activities occurred on 35 different farm units.

Approximate crop distribution in the watershed at the present time is 22 percent corn, 62 percent hay and pasture, and 16 percent small grains. The average sale of farm products in 1964 was \$6,934 per farm. Agricultural land values range from \$100 to \$600 per acre. Land in the flood plain that has potential for recreational, residential or industrial development is estimated to have an average value of \$1,000 per acre.

Present population of the watershed is estimated to be 2,000, which amounts to about 11 persons per square mile. All of the inhabitants live in rural areas or small villages ranging from 2 to 7 miles apart. Density of population for the State of West Virginia is 77 per square mile.

In 1969, 54 percent of the farm operator households indicated an income of more than \$2,500 from the sale of farm products. Good markets are available for agricultural products in this area. Contract marketing arrangements with feed companies are readily available for broiler producers. Local markets are good for quality sawlogs, veneer logs and railroad ties with fair to good markets for pulpwood. In 1967, the total work force in Hardy County was 2,840 of which 330 were unemployed. The average unemployment rate over a 3 year period from 1965 to 1967 amounted to 10.3 percent.

Between the years 1960 and 1970 there was a 4.9 percent decline in population. The out-migration was primarily to metropolitan urban centers. The public service assistance program had a case load of 405 in 1965, and the total amount allocated to the county for this purpose was \$205,000.

This watershed is within the boundary of the eight-county Potomac Headwaters Resource Conservation and Development Area. Hardy County is also within the corporate boundaries of the Upper Potomac Economic Development District and the five-county Potomac Valley Soil Conservation District.

Land Treatment Data

Land use in the watershed is under a gradual change mainly due to small farms being purchased by larger operators and the increase of part-time farmers. The change is mainly in upland areas where cropland is changing to grassland. Future land use projections to the year 2000 show a 32 percent reduction in cropland. The average size farm today is 200 acres compared to 150 acres 20 years ago. Some increase in forest land is also occurring as poorer land is removed from agricultural production. Urban dwellers, mainly from the Washington, D.C. area, are also purchasing farmland for recreation purposes.

Present land use is 8 percent cropland, 17 percent grassland, 74 percent forest land, and 1 percent miscellaneous. Overgrazing on pastureland is common with only about 15 percent of this land adequately treated. On forest land, 8 percent is in very poor hydrologic condition, 69 percent is in poor condition, 18 percent is in fair condition and 5 percent is in good hydrologic condition. Other land uses are in fair to good hydrologic condition. Most forest areas are improving as a result of better protection. Seriously eroding areas are found on steep overgrazed pastures, streambanks, roadbanks and recently constructed logging roads.

Present forest stands are 88 percent hardwood (mainly the oak types with their various associated species, including some beech-birch-maple), 8 percent mixed stands (oak mixed with pitch, white, shortleaf, and Virginia pine), and 4 percent pine types. About 29 percent of the forest stands are of saw timber size, 50 percent in pole size stands, and 21 percent in seedling and sapling size stands.

There are 15,800 acres of public forest land in the watershed. About 3,700 acres are located in Lost River State Park and administered by the West Virginia Department of Natural Resources. The remaining 12,100 acres are located in George Washington National Forest. The balance of the forest land is held by an estimated 400 owners with an average size forest holding of 175 acres. A small acreage of forest land is owned by industry.

Adequate forest fire protection is provided on National Forest Land by the U.S. Forest Service and on State and private forest land by the West Virginia Department of Natural Resources in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Forest Fire Control Program. Other current Federal-State cooperative forestry programs include Cooperative Flood Prevention Program, Cooperative Forest Management, Cooperative Forestation and Cooperative Insect and Disease Control.

The Potomac Valley Soil Conservation District directs a balanced land treatment program in this area. Within the watershed boundary there are 393 farms. Of this total, 337 are district cooperators and 271 of these land-owners have developed soil and water conservation plans. Cooperators with the district own approximately 68,747 acres or 58.6 percent of watershed land. Approximately 25 percent of the conservation practices planned on cooperator farms have been established.

Fish and Wildlife Resource Data

Lost River Watershed is regarded as one of the outstanding hunting areas in West Virginia and surrounding states. Primary game species present are squirrel, grouse, turkey and deer. Hunters, mainly from the eastern metropolitan areas, spend an estimated 15,500 hunter-days annually in the watershed. This resource has an estimated value of \$102,000 annually.

Fishing within the watershed boundary is available in Lost River and its major tributaries -- Kimsey Run, Lower Cove and Camp Branch. This sport is mainly limited to the spring months when the West Virginia Department of Natural Resources conducts a put-and-take trout stocking program. In 1970, 4,361 pounds of trout were stocked in Lost River and 167 pounds in the major tributaries. Some limited fishing for smallmouth, largemouth, rock bass and sunfish is available. Low flows during summer and fall months restrict these species. An estimated 6,500 fishing days are spent in the watershed annually resulting in an average annual value of \$32,500.

Located approximately 2 miles east of the watershed boundary are Trout Pond, a 1-acre natural lake, and recently completed Rock Cliff Lake, with a surface area of about 14 acres. These lakes are located within the George Washington National Forest and are primarily for trout fishing. Warden Lake, constructed by the Department of Natural Resources, is located approximately 4 miles north of the watershed boundary and has a surface area of 36 acres. The lake provides year-around warm-water fishing and put-and-take trout fishing during the spring months.

Recreation Resource Data

This rural watershed has many natural resources for attracting visitors, which include outstanding mountainous scenery with farmsteads and high quality free-flowing streams. Residents of eastern metropolitan areas frequently visit this area for weekends or summer vacations.

The only public developed recreation facility within the watershed boundary is Lost River State Park, operated and maintained by the West Virginia Department of Natural Resources. This 3,700-acre park has facilities for swimming, picnicking, hiking, horseback riding and games. Also available are 24 cabins for rental, a recreation building and a park restaurant. There are approximately three farms in this watershed that participate in the state-sponsored vacation farm program. These farm owners provide food and lodging and farm experiences for their guests. Some have horseback riding facilities and small farm ponds for fishing. This type of recreation has been very popular and also a profitable part-time business for farm operators. Other developed recreation facilities near this watershed are as follows:

1. Spruce Knob-Seneca Rocks National Recreation Area: This 100,000-acre recreation area was established by Congress in 1965 and is located approximately 45 miles west of the watershed. This area is being developed by the U.S. Forest Service as part of the Monongahela National Forest to provide public outdoor recreation for the people of the United States. Facilities will be available for camping, swimming, fishing, picnicking, hiking and scenic overlooks.

2. Wolf Gap Recreation Area: This development, located approximately 10 miles south of Wardensville in the George Washington National Forest, provides about 15 camp sites for tents or trailers and 10 picnic tables.

3. Hawk Recreation Area: This development is located approximately 4 miles northeast of Wardensville in the George Washington National Forest and has 15 camping units and about 20 picnic tables for use. There is also a group camping facility available.

4. Rock Cliff Recreation Area: This development for camping, picnicking and fishing, located in the George Washington National Forest approximately 2 miles east of the watershed boundary, is presently being expanded. The original development included only a picnic area around a 1-acre natural lake. A new 14-acre lake, mainly for trout fishing, has been constructed with camping and picnic units being installed at present. The final development will include 160 camping and 100 picnic units.

Warden Lake, discussed under "Fish and Wildlife Resource Data," is primarily a fishing lake and has only a limited number of picnic tables. Sanitary facilities are also available.

WATERSHED PROBLEMS

Floodwater Damage

An estimated 1,990 acres of the watershed, excluding stream channel, is flood plain, and is the area inundated by the 100-year frequency runoff. Floods that cause damage estimated to exceed \$284,000 occur about every 10 years. Local people generally remember the floods of 1936, 1942, 1949 and 1970, and readily recall the flood of 1954, which was the result of Hurricane Hazel. The frequency of a flood of this magnitude was determined to be a little less than 10 years, and a repeat would cause damage estimated at \$250,000. Estimates show that there is a 1 percent chance that floodwater will exceed high-water marks of 1954 by about 4 feet. This would occur on an average of once in 100 years and would cause about \$705,400 in damages.

On an average annual basis, direct damage within the watershed flood plain amounts to \$151,900. Table 5 divides this into damages by types of property.

The above-mentioned damage area extends from the headwater of the watershed above Mathias to Wardensville. Another problem area associated with this project extends downstream. Direct average annual downstream damages have been specifically identified on the contiguous Upper Cacapon River flood plain and amount to \$88,000 annually.

Direct average annual damages to flood plain properties by type (see Table 5) are arrayed as follows:

Downstream sediment	\$217,400
Downstream floodwater	88,000
Floodwater (on-site):	
Crop and pasture	30,800
Dwellings	28,000
Other agriculture	27,400
Streambank	20,800
Road and Bridge	18,700
Commercial	13,300
Erosion	8,100
Sediment	<u>4,800</u>
Total	\$457,300

Cause and effect of downstream sediment is discussed hereafter under sediment damage.

Properties involved in downstream floodwater damage include 7.5 miles of paved road, 4 bridges, 97 cottages, 8 farmsteads and approximately 2,000 acres of crop and pastureland. Another 527 acres of crop and pastureland exists "on-site" which floods at least once every 5 years.

Income lost from crop and pastureland that could be restored with project action was counted as crop and pasture damage under present conditions. This amounted to \$26,400 annually.

One hundred and twenty farm units are subject to flooding. Damage to other agriculture includes about 11,000 rods of fence, eight poultry or broiler houses, 35 large farm buildings and numerous small sheds, etc.

Streambank and erosion damage are discussed under erosion damage.

Approximately 2.5 miles of paved road and 25 bridges are subject to floodwater damage.

Eleven commercial establishments receive frequent flood damage.

Several flood plain landowners are aware of the constraint that flooding has on land use for recreational purposes. The potential net income foregone by this adverse effect is estimated at \$17,500 annually.

Sediment Damage

Flooding of the main stream deposits fine-grain sediment over much of the flood plain and coarse, infertile material at localized areas. The coarse deposits damage agricultural land and represent a direct economic loss to the farmers. Bedload moves during high flows can restrict bridge openings, destroy fords and alter fish habitat.

Sediment yields from the subwatershed contribute to the total sediment load of the Potomac River which causes problems in downstream areas. The present sediment yield of Lost River is estimated to be 34,457 tons per year. Annual sediment damage in the watershed and downstream is estimated to be \$222,200.

Damageable resources include metropolitan water supply, navigation, commercial fishery, sports fishery, boating and aesthetics.

Intakes for Washington, D.C. water supply aqueduct are located at Great Falls and Little Falls. Discussions with plant personnel indicated a higher treatment cost when sediment must be dealt with.

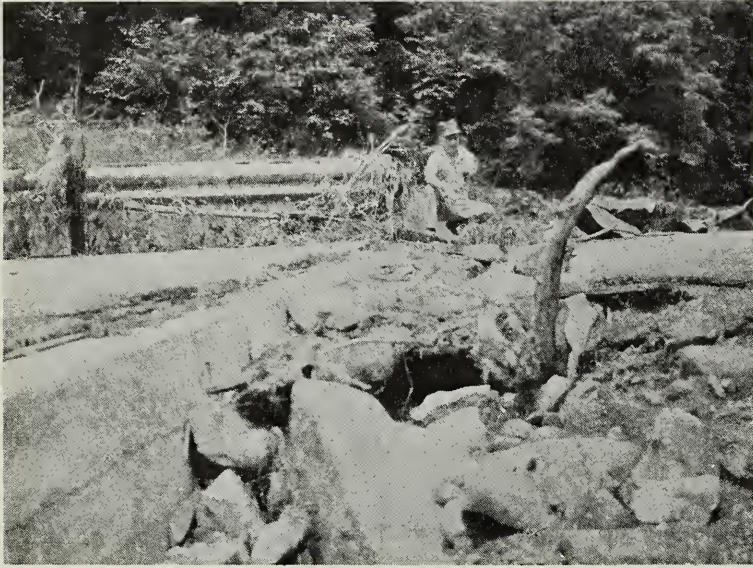
The Potomac estuary is navigable up as far as Washington, D.C. Dredging to maintain a 24-foot wide channel is necessary. Almost 90 percent of the cost of dredging is attributable to spoil disposal. Available areas for dumping are becoming scarce and restrictive.

Dockside value of 17 million pounds of fish, crabs, clams, and oysters produced in the Potomac estuary amounted to \$4,500,000 in 1969. The estuary is in a strategic location for recreational as well as commercial fishing. Despite desirable natural features, there is a low density of aquatic life. Sports and commercial species are damaged by sediment because of reduction in sunlight penetration, changes in temperature, clogging of gills and smothering of spawning beds and eggs.

There are an estimated 50,000 pleasure boats which use the Potomac. Boating enthusiasts have been pleading for a cleaner Potomac for several decades. Their problems include muddy water, silt bars, algae blooms, sewage, foul odors and floating debris. If the river were cleaner, boating could easily increase 33 percent.

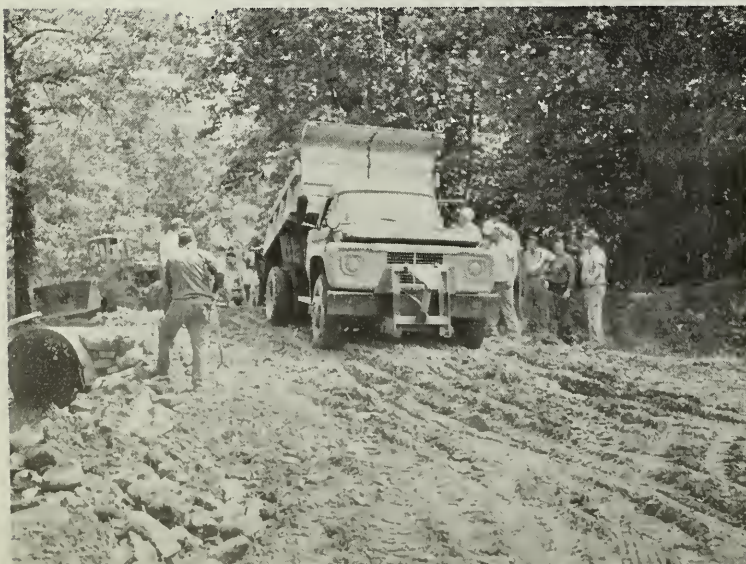
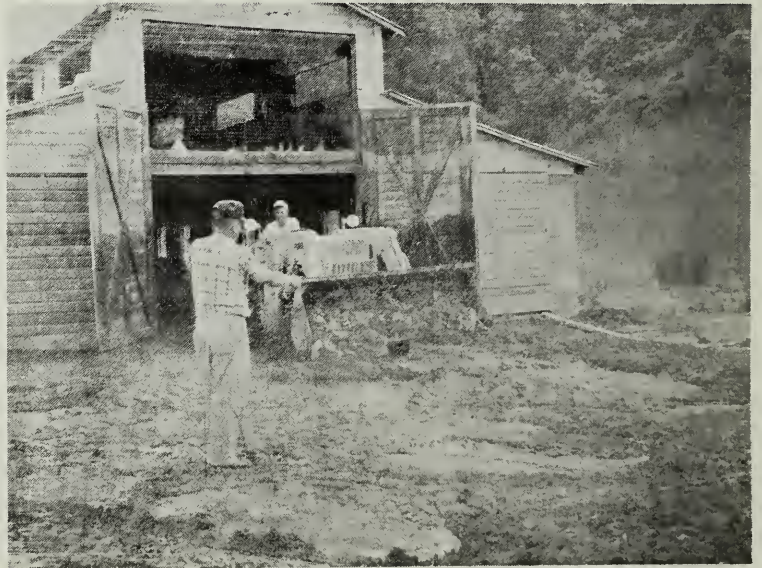
Natural parks, memorial structures, a national cemetery and hundreds of high-rise apartment buildings have been placed overlooking the Potomac. A problem to the viewing enthusiast is that of unsightly muddy water and repulsive debris.

All above-mentioned downstream sediment damages are further described and documented in a publication prepared for the U.S. Department of the Interior. A private sector chemical company applied research on this subject specifically to the Potomac River. Further reference to the report, including dollar damage estimate per ton of sediment, is found elsewhere in this plan.



Bridge near Mathias, West Virginia,
showing damage caused by flood
of July 1970

The flood of July 1970 drowned
10,000 broilers in this poultry
house



West Virginia Department of
Highways replacing culvert wash-
out during July 1970 flood



Streambank erosion along Lost River



Sediment deposit in Lost River eroded from upland areas causing reduced stream capacity

Erosion Damage

Out-of-bank flows have created scour channels in the agricultural flood plain in the areas experiencing frequent flooding. These areas are generally used less intensively than the locations with less frequent flooding. The most prominent erosion is sheet and rill erosion on steep pastures, recently constructed logging roads and roadbanks. There is little land outside the main valleys used for row crops. Most of the upland is in forests, pasture, or permanent hay. An average erosion rate of 3.4 tons per acre was determined for the areas above potential dam sites. Streambank erosion is noticeable at sharp meanders or where obstacles on one side of the channel have diverted the flows toward the opposite bank. Critically eroding areas consist of about 15 acres of small, scattered, bare areas on steep pastures and approximately 10 acres of roadbanks. Annual flood plain erosion damage, including streambank erosion, is estimated to amount to \$28,900.

Efforts in the past to control or prevent flooding have consisted of extensive channel repair, diking and streambank stabilizations. These efforts have had little effect on the reduction of flood damage and have a very high maintenance cost. Approximately one-third of the farmers along the stream engage in annual channel repair work. Despite these efforts, 527 acres are flooded by the 5-year frequency event. This has restricted land use.

Problems Relating to Water Management

Municipal and Industrial Water: The town of Wardensville distributes an approved quality of water to approximately 400 residents. A large spring on White's Run provides an adequate source for present and future needs. Other small villages and rural homes use springs or individual wells for water. These supplies are also considered to be adequate for present and future needs.

Water Quality: Water quality problems are not considered to be of any significance in this watershed. Some sediment and human and animal pollution is present, but to a limited extent. Low flows in summer and fall months present some problems.

Recreation: The demand for developed recreational facilities in this area is great. Present and future planned facilities are inadequate to meet the need. Within a 7-hour drive of this watershed, there is a population of more than 9 million people. The population within a 50-mile radius, which includes Hardy County and seven adjoining counties, is about 160,000. The standard metropolitan areas of Washington, D.D.; Baltimore, Maryland; Lynchburg, Virginia; Johnstown, Altoona, and Pittsburgh, Pennsylvania, are all within a 5-hour drive of this area.

Additional recreational facilities are greatly needed for camping, picnicking, swimming and fishing. The lack of a year-round fishery is also a problem.

Local interests have been reluctant to provide adequate opportunities for public recreation, mainly due to financial reasons. Private owners are also hesitant to grant permission to use their land for fishing and hunting.

Fish and Wildlife: Problems relating to fisheries include low summer stream flows, lack of sufficient lake waters, poor facilities to accommodate fishermen and their families, and too few public access areas. Game resource problems are posted private land, improper timber harvest practices, and too few designated public hunting areas to adequately provide for the hunters. Road building in timber areas may present some future erosion problems if the roads are not properly located, constructed and maintained.

PROJECTS OF OTHER AGENCIES

There are no existing or proposed works of improvement in the Lost River Subwatershed under other authorities which would affect or be adversely affected by the works of improvement in this plan.

A public recreational development, located approximately 2 miles from this watershed and known as Rock Cliff Lake, is presently being developed by the U.S. Forest Service as part of the George Washington National Forest. A variety of activities, including fishing, camping, and picnicking, are planned around the 14-acre lake. Effects of this development have been considered in the formulation of the recreation portion of this plan.

PROJECT FORMULATION

Watershed problems relating to land and water resources were studied by the Sponsoring Local Organizations and concerned Federal, State, and local agencies. Possible solutions to these problems that could be provided under the authorities of Public Law 534 were considered in project formulation.

The Sponsoring Local Organizations and the Service agreed that a project would be formulated to meet the following objectives:

1. Management and development of soil and water conservation practices will be stressed throughout the project area during the installation period. Future land use adjustments will be made which will contribute to effective utilization of all land in the watershed. This will include both urban and agricultural land, renovating old and establishing new conservation practices where needed, and improving the economic conditions of low income-producing areas.
2. Flood damage protection will be provided to the agricultural lands along the main stem of Lost River and as far upstream on each major tributary as can be economically justified. Protection will be provided from the 5-year to 10-year frequency event.
3. Protection will be provided against sediment and scour damage to the agricultural lands and stream channels within the watershed. Objectives will be to reduce this type of damage by 50 percent.

4. Reduction of floodwater damage to roads and bridges will be stressed. Protection will be provided to assure that major highways are open to safe travel during the 100-year frequency event.

5. Preservation and improvement of existing fish and game resources will be emphasized when assisting landowners in developing and installing a conservation plan and while coordinating the project measures with the West Virginia Department of Natural Resources and the U.S. Fish and Wildlife Service.

6. Increase the opportunities for public recreation and fish and wildlife resources in the watershed by providing a multiple-purpose recreational lake and associated developments for fishing, boating, camping, picnicking and swimming.

ALTERNATIVES

Alternative plans to the selected project can be divided into three main categories - nonstructural, structural, and no project. In the first two cases, there are numerous possibilities and combinations thereof, but not all are realistic. Therefore, the unrealistic alternatives were not explored past the point where they proved unworkable.

Nonstructural alternatives explored include a land treatment program, floodproofing, HUD flood insurance, flood plain management, floodwarning, and outright purchase of the flood plain. Structural alternatives include a stream channel modification, diking, floodwater retarding dams, and a single-purpose recreation dam.

Nonstructural

Land Treatment Alone - This alternative would provide technical assistance to keep conservation and woodland management plans up-to-date, to develop new plans as land ownership or land use changes, to maintain existing adequate cover and maintain installed land treatment measures, and to plan and apply applicable treatment measures on land requiring treatment. Additional land treatment measures would be applied to adequately treat all of the lands of the watershed.

Land treatment would include conservation practices such as conservation cropping systems, critical area treatment, pasture and hayland management, forestry improvement, wildlife management, and other improvements as described under the land treatment measures of the planned project section.

The cost of the land treatment plan would be about \$470,500. This alternative plan would improve the hydrologic condition of the watershed, reduce flood flows by about 2.9 percent and provide a limited amount of fish and wildlife and recreation opportunity.

This plan would meet the selected objectives of the sponsors for a land treatment program. The plan does not provide flood protection from the 100-year frequency flood to urban areas, nor does it provide 5-year frequency flood protection to agriculture land.

Land treatment will reduce the amount of sediment leaving the watershed by 2,810 tons annually. Both vegetative and structural types of land treatment measures will effectively reduce runoff, conserve soil moisture, and prevent excessive loss of topsoil. Many land treatment measures will enable landowners to more fully utilize sound land treatment practices to increase efficiencies of production, improve wildlife habitat, improve water quality, and improve aesthetics in the watershed.

Land treatment measures would not involve the relocation of any residences or improvements. Farmland, streams, and wildlife habitat would not be inundated by flood retarding structures. Watershed residents and vacationers would have to seek recreational opportunities associated with impounded water outside the watershed. Any increases in traffic, noise, and litter associated with a recreational development would also be avoided.

Land Treatment, Floodproofing and Flood Insurance - For this alternative, the land treatment program would be installed, as many homes and businesses floodproofed as practical, and flood insurance would be made available to eligible property owners. The benefits and impacts of the land treatment program would be realized.

Floodproofing would be required for 23 dwellings and nine commercial establishments that are located on the flood plain. Each building would need to be altered in such a way that property damage would not occur from the 100-year frequency flood.

Future flood plain improvements would be restricted to projects that would not contribute to the flooding problem nor be susceptible to flood damage. Floodproofing would require the construction of a wall around existing properties and would cost a minimum of \$10,000 per property. Cost of this measure would be borne by watershed residents. Total cost would be approximately \$320,000.

It would not be practical to floodproof such properties as roads, bridges, most outbuildings, fence, livestock, and poultry; and these items are not eligible for flood insurance. Remaining direct annual damage on the Lost River flood plain, after all practical floodproofing, would amount to an estimated \$83,200.

In order to obtain flood insurance for this rural area, it would have to be approved for participation in the National Flood Insurance Program administered by the U.S. Department of Housing and Urban Development. The area would be required to adopt flood plain zoning ordinances. Flood insurance would reimburse participating landowners for financial loss from flood damages according to the guidelines of the insurance program.

Through the imposed land use controls, future development of the flood plain would be restricted. The existing development on the flood plain would remain essentially the same.

Value of all property subject to flood damage, including off-site properties, is estimated at \$9,912,400. Eligible for flood insurance would be properties with a value estimated at \$2,011,000. This amounts to 22 percent of the total and includes dwellings, commercial establishments, and most of "other agriculture." The annual subsidized premium cost would be about \$7,000. At non-subsidized rates, the annual cost would amount to approximately \$70,000. Technical inputs for a flood insurance hazard study would cost about \$30,000. If all legitimate claim awards are paid in full over the life of the project, the cost of flood insurance would approach an amount equal to average annual damage without a project; \$133,700 for the insurable items. Purchase of subsidized flood insurance by residents would provide a means of recovering a portion of flood losses.

The insurance payments for flood damages incurred by participants in the program provide reimbursement for the value of property and content damaged. Payments would not be adequate, however, to totally replace the item destroyed or damaged, nor provide for such related items as cleanup, inconvenience and other indirect damages.

Ineligible for flood insurance would be properties with an estimated value of \$7,181,400. This amounts to 78 percent of the total and would include such items as roads, bridges, growing crops, pasture, fence, lawns, shrubs, trees, livestock, poultry, and land. Streambanks are not insurable and value of this item is not included above. Direct average annual damage to non-insurable items is estimated at \$105,600.

This alternative would not lower the 100-year frequency flood in the urban area nor have any effect on the flooding of agricultural land. The adverse environment effects of the planned project which would be avoided if this alternative is implemented, would be the same as those listed under the "Land Treatment Alone" alternative.

Floodproofing structures around residences would detract from the high quality aesthetics of the watershed. Continued flood damage and restriction of more intensive flood plain use would curtail economic development of Lost River Watershed. This alternative would meet the sponsors' objective for a land treatment program but would not provide flood protection to agricultural land or provide needed recreation facilities. Total cost of this alternative is \$2,356,500.

Structural

Land Treatment and Recreation Only - A single-purpose reservoir to supply needed recreational opportunities would be constructed similar to proposed site 16. This development would create a 50-acre recreation lake and supply 164,700 annual visitor days.

The dam could be built with a water level control feature to manage aquatic habitat more effectively. This development would provide fish and wildlife habitat improvement.

There would be increases in noise, sediment concentrations in streams, smoke and dust pollution of air, and accelerated erosion during construction activity. Vehicular traffic, noise and litter would increase as a consequence of greater human use. Installation of the structure and associated facilities would require the relocation of three residences, would inundate 50 acres of farmland and associated wildlife habitat and would eliminate 0.6 miles of stream. This alternative would meet the sponsors' objectives of land treatment and recreation but would not provide flood protection to agricultural lands. The benefits and impacts of the land treatment program would be realized.

This alternative would cost approximately \$1,236,400, of which \$765,900 would be for the single-purpose structure.

Land Treatment, Stream Channel Modification and Diking - This alternative consists of approximately 15 miles of channel work, diking, riprap and bridge underpinning.

Total cost of this alternative would be about 15 million dollars.

It would provide 100-year frequency protection to the urban areas and 5-year frequency protection to agricultural lands.

The benefits and impacts of the land treatment program would be realized. Approximately 15 miles of high quality free-flowing streams would be removed as a fishery and aesthetic resource. Installation of structural measures will create temporary interruptions of traffic, electrical power, telephone communication, and natural gas distribution. Construction operations would also cause temporary increases in noise, turbidity and sediment concentrations in streams, erosion of construction sites and dust and smoke pollution of air.

Installation of this alternative would not require the relocation of any residences. Higher peak flows resulting from channel work would induce downstream damages. Water based recreational activities would be reduced in the watershed. Structural measures proposed in this alternative would disrupt the rural aesthetic setting of the watershed.

Land Treatment, Floodwater Retarding Structures and Recreation - In this alternative, 20 reservoir structures rather than five were considered from the standpoint that a higher level of flood prevention could be achieved. They were designed essentially the same as those included in the planned project.

The combined cost for these structures is about \$22,500,000.

This structure system would provide 100-year frequency flood protection to most residences and approximately 25-year frequency flood protection to the flood plain.

About 1,800 acres would be committed to this project for sediment pools, retarding pools, recreation pool and facilities, dams, emergency spillways, and borrow areas. Approximately 9 miles of stream channel would be eliminated with this alternative.

Considerable time and effort were put into a study of an alternate system which would have placed a multiple-purpose site on Howards Lick Run near the Lost River State Park. The system was not feasible because of high land rights costs and extensive relocation problems. Another alternate was carefully considered, but contained sites that would have been located further upstream on Kimsey Run and Dove Hollow. This proposal was not used because of less net benefits and a lower level of protection.

There would be noise, water and air pollution and accelerated erosion during construction activities. The sponsors' objectives of land treatment and flood protection to agricultural lands would be realized. Downstream sediment damage to the Potomac River and estuary would be reduced. Approximately 465 acres of warm-water fishing and waterfowl habitat would be created. Installation of these structural measures would require the relocation of approximately 35 residences.

Flood Plain Purchase - The initial cost of buying out all properties, inclusive of relocation payments and severance damage, is estimated at \$6,885,100. Marketable agricultural commodities produced on the flood plain have an estimated net annual value of \$145,000. If capitalized at current interest rates for the period of the project, the present value is \$2,575,800. Addition of this opportunity cost would bring the overall price of flood plain purchase up to \$9,460,900.

In 1971, the assessed value of all Hardy County real estate amounted to \$15,347,955. The average ratio of assessment to market value was 0.358 and the average tax rate per \$100 was \$1.41. At this rate, public acquisition of the affected flood plain properties would reduce the tax revenue of local governments and school districts by an estimated \$24,700 annually.

Replacement of prime flood-free agricultural land equivalent to the Lost River flood plain would be impossible in West Virginia.

No Project

The final alternative considered for Lost River Watershed was that of "no action." If the project is not considered, there would be no concentrated activity directed toward solving the water and related land resource problems that exist in the watershed.

At the present, there is an on-going land treatment program in Hardy County. A portion of this effort is applied to the lands in the watershed. About \$13,900 is spent each year to carry out the on-going land treatment program. This includes the cost to install the treatment measures and for technical assistance. It would be expected that this activity would continue at the same rate as the present.

The net annual monetary benefits that would be foregone, if the planned project is not implemented, are \$103,300.

If no project is considered for the watershed, the serious resource problems, need for public recreation, and stimulation of economic condition that the Sponsors are trying to solve, would remain the same.

All of the adverse environmental effects of the planned project would be avoided.

REASONS FOR SELECTING THE PLANNED PROJECT

The selected project outlined in this work plan was formulated to include a system of feasible measures that would provide a favorable solution to soil and water problems of the watershed. In keeping with the desires of the Sponsoring Local Organizations, the project was formulated to meet the six objectives agreed upon.

An intensified land treatment program was selected in formulating a project for development and protection of the watershed. Proper use of land, based on capability and the required treatment measures, were recognized as essential elements for the proposed project. Establishment of income-producing enterprises on individual farms was recognized as an important element in present and future farm management. Special consideration was given to land treatment practices to improve wildlife habitat and fish production. The acres of cropland, grassland, miscellaneous land, and forest land that would be treated during the project period were determined by the Sponsoring Local Organizations with the assistance of the West Virginia Department of Natural Resources, the U.S. Forest Service, and the Soil Conservation Service.

A system of four single-purpose and one multiple-purpose floodwater retarding structures was determined to be necessary to supplement a land treatment program to achieve the agreed-upon level of protection. Sites for the five structures were selected after consideration was given to the areas that would be protected and the areas that would be adversely affected by the structures. In the selection process, over 30 alternate sites were considered. The other sites were dropped from the project due to high construction costs, poor storage characteristics, lack of suitable construction materials, and a poor hydrologic effect in the damage areas. Stream channel improvement to include diking was considered, but was not feasible due to steep gradients, high velocities, and the large channel size required to give the agreed-upon protection.

The five structures proposed in this work plan are 4, 10, 16, 23, and 27, as shown on the project map. This system of five structures were selected over one with many smaller structures in order to meet project objectives. Selection of this system, and location of the sites, was influenced by the physical drainage pattern, geological strata, and the topography of the watershed in relation to the damageable areas.

Structure No. 16 was selected for recreational development by the Sponsoring Local Organizations, with the assistance of the Soil Conservation Service. Selection of this site was based on an investigation of population centers, access to and from the site, soils and geologic conditions, natural scenic areas, quality and quantity of water, and topography of the area. All agencies concerned agreed that water quality at this site was adequate for the types of recreation needed to meet the objectives of this plan.

Cold-water releases will be included in Structures No. 4 and No. 16 as measures to prevent any significant change in downstream water temperatures. The effects of structural measures on fish and wildlife were thoroughly evaluated and closely coordinated with the Wildlife Resources Division of the West Virginia Department of Natural Resources.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

To achieve adequate land treatment within the scope of project objectives, 94,750 acres of watershed land will be treated. This includes 1,400 acres of cropland, 7,000 acres of grassland, 86,300 acres of forest land, 25 acres of miscellaneous land, and 25 acres of critical area stabilization.

Practices planned for cropland include such conservation practices as conservation cropping systems, tile drains, and grassed waterways. On grassland, practices will consist of pasture and hayland planting, pasture and hayland management, spring developments and farm ponds. Forest land practices on private land will include tree plantings, hydrologic stand improvement, woodland grazing control, skid trail and logging road erosion control, protection and forest land management. The existing program of the U.S. Forest Service on National Forest System Lands, which includes erosion control, reforestation, silvicultural treatments, fire control, and resource development, will be continued at the same rate. In addition, the following practices will be installed by the U.S. Forest Service on National Forest Lands under the accelerated program: rehabilitation of 13 miles of abandoned roads and trails, one-half mile of gully and 5 miles of streambank stabilization, 11 miles of stream channel clearance, and 100 acres of sheet erosion control.

Practices such as tile drains and tree plantings are planned for miscellaneous land. Critical area stabilization will consist of planting 10 acres of roadbanks and 15 acres of bare areas in pasture. Other alternatives and equally applicable treatment measures are outlined in the Soil Conservation Service Technical Guide for this area.

Soil surveys will be completed on the total watershed area (117,200 acres) during the installation period. Man-hours to do this work are estimated to be 4,200.

Basic resource conservation plans will be developed for approximately 50 soil conservation district cooperators. This includes 30 conservation plans under the going program and 20 under the accelerated effort. A main objective will be to assist the district in revising 50 conservation plans. Forty-five of these will be under the accelerated program and five under the existing program. In addition, 90 individual forest management plans will be prepared for landowners.

Structural Measures

Supplementary to the land treatment measures in meeting project objectives five floodwater retarding structures are planned for this watershed. They will control runoff from 64.75 square miles of drainage area or 35 percent of the total watershed area. Location of each of the structural measures is shown on the project map in the back of this work plan.

All of the structural measures are planned as earth and rock fill dams with an expected useful economic life of 100 years. A two-stage principal spillway system will be provided that will automatically control runoff resulting from all storms up to the 100-year frequency. Flow resulting from storms greater than the 100-year frequency will be routed safely around the dams through the emergency spillways. The emergency spillways will be excavated into rock (shale or sandstone), and flood flows will pass through at non-erosive velocities.

The structure sites have no known earthquake hazards. Foundation material is stable bedrock consisting of sandstones and shales of the Devonian System and shales of the Ordovician System. Soils in the foundation consist of colluvial sands and gravels and range in depth from 4 to 15 feet.

Borrow material for the embankments is adequate and in sufficient quantities. It will consist of residual and colluvial clays, alluvial gravel, and shale from emergency spillway cuts. The characteristics of the borrow material have been considered in the design of the embankments to minimize earthquake hazards.

Each dam was planned with a storage allowance for sediment that is anticipated to accumulate over the useful life of the structure. This will create a sediment pool above each structure ranging in size from 6.5 acres at Structure No. 27 to approximately 70.0 acres at Structure No. 4.

Structure No. 4 is located on Kimsey Run approximately three-quarters of a mile upstream from its confluence with Lost River at 39° 56' N latitude and 78° 49' W longitude. This structure has a drainage area of 32.60 square miles and is planned to store 6,792 acre-feet of floodwater to the crest of the emergency spillway, which is equivalent to 4.01 inches of runoff over the entire drainage area above the dam. In addition to the flood storage, allowance was made to store 653 acre-feet of sediment or 0.38 inches from the total drainage area. Water will initially be stored in the space reserved

for sediment up to the elevation of the 100-year submerged sediment accumulation creating a pool with a surface area of approximately 70 acres. Passage of the emergency spillway design storm through the structure will create a flood pool with a surface area of 214 acres.

Storing this amount of floodwater requires a dam approximately 100 feet high, which will contain around 1,020,150 cubic yards of compacted earth and rock fill. It is anticipated that most of the fill material will come from the flood pool above the dam and the emergency spillway. Geologic investigations, conducted by digging test holes with a backhoe to determine the type and amount of material present that could be used for "borrow", indicate that material for construction of the dam will be readily available. A 500-foot wide emergency spillway will be excavated around the dam through the low ridge on the right abutment. Excavation of the emergency spillway will require the removal of approximately 199,500 cubic yards of earth and rock. Most of the rock will be shale; however, it is anticipated that about 16,600 cubic yards will be rock excavation.

It is anticipated that the emergency spillway will be excavated through material classified as moderately soft shale, which is considerably more resistant to erosive forces than earth. The spillway will pass through a wide abutment and empty directly into Lost River. Since the drainage area of this dam is over 10 square miles, it was planned with a concrete crest control structure to assure safety of the spillway against breaching and subsequent failure, in compliance with SCS Engineering Memorandum 6, dated July 19, 1972. The structure will require about 950 cubic yards of reinforced concrete to construct.

The principal spillway system was planned as a two-stage concrete riser outletting through two 48-inch diameter concrete conduits into a concrete outlet basin. The riser was planned to include provisions for releasing cold water into the stream below the dam to preserve the existing trout fishery. The entire principal spillway system will rest on a shale foundation. Installation of this system will require approximately 1,043 cubic yards of reinforced concrete.

Land rights, which will have to be obtained prior to installation of this structure, include the purchase of easements on 257.2 acres of land. This is the area to be used for construction of the dam and emergency spillway, storage area above the dam and borrow areas. Purchase and removal of three farmhouses and associated barns and outbuildings will also be necessary. Approximately 1.5 miles of hard surface road, 6,100 linear feet of electric lines and 8,700 linear feet of telephone cable will need to be relocated. A small cemetery located within the flood pool area about 1,700 feet above the dam will have to be moved prior to installation of this structure.

Structure No. 4 will require relocation of two home-owner dwellings, one rental dwelling and three farm operations. Nine persons are involved in relocations at this structure.

Estimated installation cost of Structure No. 4 is \$1,993,700 of which \$1,329,500 is for construction of the dam and emergency spillway, \$291,600 is for land rights, \$23,100 is for relocation payments, and \$349,500 is for engineering services and project administration.

Structure No. 10 is located on Camp Branch, which is a tributary of Baker Run, about 1.0 mile upstream from Needmore, West Virginia, at 39° 02' N latitude and 78° 48' W longitude. This dam will control runoff from 6.69 square miles of drainage area and will be about 78 feet high. It will require approximately 330,550 cubic yards of fill material to construct the earth and rock embankment. Fill material will come from the flood pool area, the emergency spillway excavation, and the flood plain immediately below the dam. It appears that enough suitable borrow material for construction of the embankment is available within the site area.

This structure was planned to allow storage space for 1,434 acre-feet of flood storage and 218 acre-feet of sediment storage. This is equivalent to 4.02 inches of flood runoff and 0.61 inches of sediment accumulation respectively. Surface area of the 100-year sediment pool will be around 18.5 acres while the emergency spillway design storm will cover 65.5 acres.

A 300-foot wide emergency spillway has been planned for this structure. It will be excavated around the dam on the left side of the valley and will exit into a small hollow draining into Camp Branch below the dam. Approximately 123,300 cubic yards of material will be excavated from the emergency spillway. About 28,800 cubic yards of this material will be rock excavation.

The principal spillway system will rest on a sandstone and shale foundation. It will consist of a two-stage concrete riser, a 42-inch diameter concrete conduit, and a concrete outlet basin at the downstream end of the conduit. To install the principal spillway will require about 355.0 cubic yards of reinforced concrete.

Installation of Structure No. 10 will require easements on approximately 84.3 acres of land and the relocation of one owner-occupied dwelling involving two persons. One farm operation will require replacement and an outbuilding within the flood pool area will also have to be removed. Utility relocations consist of raising approximately 800 feet of hard-surface road an average of 6 feet in elevation, relocation of 1,900 feet of telephone lines, and 4,400 feet of electric power lines.

Installation of this structure will cost approximately \$759,600 of which \$562,000 is for construction, \$41,200 for land rights, \$8,800 for relocation payments, and \$147,600 for engineering and project administration.

Structure No. 23 is located on Cullers Run about 2.5 miles upstream from its confluence with Lost River, and about 1.0 mile below the Cullers Run School at 38° 51' N latitude and 78° 55' W longitude. This structure will control runoff from 9.95 square miles of drainage area and was planned to store 2,123 acre-feet of temporary floodwater and 337 acre-feet of sediment below the crest of the emergency spillway. This is equivalent to 4.00 inches of flood runoff over the entire structure drainage area and 0.64 inches of sediment accumulation. The 100-year sediment pool will have a surface area of approximately 22.8 acres, and the flood pool will cover 75 acres during passage of the emergency spillway design storm.

Height of this dam is estimated to be 92 feet, and it will require approximately 475,760 cubic yards of material for its construction. Most of this material is available within the sediment and flood pool areas above the dam. It is expected that about half of the 192,000 cubic yards of material to be excavated in constructing the 200-foot wide emergency spillway will also be useable as fill material for the dam. Approximately 63,670 cubic yards of the emergency spillway excavation will require excavation methods. The emergency spillway will be excavated through the left abutment and empty into the small hollow below the structure.

The principal spillway system planned for this dam will consist of a two-stage concrete riser, a 48-inch diameter concrete conduit, and a concrete outlet basin. The principal spillway will rest on bedrock, which is interbedded sandstone and shale. Installation will require placing approximately 555.0 cubic yards of reinforced concrete.

Prior to installation of the dam and emergency spillway, easements will have to be obtained on about 101.6 acres of land. Three home owners, one rental and two farm operations will have to be relocated. Relocation of approximately 1.1 mile of hard surface road and 3,960 feet of electric power lines will also be necessary.

Total cost of Structure No. 23 is estimated to be \$1,228,000, with construction of the dam and emergency spillway expected to cost \$862,400, land rights \$113,700, relocation payments \$25,600, and engineering and project administration \$226,300.

Structure No. 27 is located on Upper Cove Run approximately 3.5 miles above Mathias at 38° 50' N latitude and 78° 50' W longitude. Drainage area controlled by this structure is 3.72 square miles. The dam will provide space for storing 748 acre-feet of floodwater, which is equivalent to 3.77 inches of runoff over the entire drainage area and 0.37 inches, or 65 acre-feet, of sediment accumulation. Water stored in the space reserved for the 100-year submerged sediment will create a sediment pool of around 6.5 acres, and during passage of the emergency spillway design storm through the structure, a flood pool of 35.5 acres will develop behind the dam.

This structure is the smallest dam planned for this project with the height of the earth and rock fill embankment being approximately 73 feet high. The dam will be constructed of approximately 307,030 cubic yards of compacted earth and rock fill. Most of this material will come from the sediment and flood pool areas above the dam and the emergency spillway excavation. A bench on the right side of the valley above the flood pool elevation appears to contain material that could be used for "borrow" also. Preliminary geologic investigations indicate that enough material for construction of the dam is present within the site area. Approximately 113,900 cubic yards of material will be excavated from the 160-foot wide emergency spillway of which 3,750 cubic yards appear to be rock excavation. The emergency spillway will be constructed on the right side of the valley in shale.

A two-stage principal spillway system consisting of a concrete riser, a 36-inch diameter concrete conduit, and a concrete outlet basin was planned for this structure. The principal spillway will rest on bedrock and will require around 200 cubic yards of concrete to install.

Land rights to be acquired prior to installation of this structure include easements on 66.8 acres of land and the removal of one barn and three outbuildings from within the flood pool area. Approximately 4,800 feet of dirt road and 4,200 feet of electric and telephone lines will have to be relocated. A large gas line in the upper region of the flood pool will be inundated on a frequency of once every 50 years. This line will be weighted and, in turn, protected from damage during large floods.

Estimated installation cost of this structure is \$647,000, with construction of the dam and emergency spillway expected to cost \$474,600, land rights \$48,400, and engineering and project administration \$124,000.

Structure No. 16 is planned as a multiple-purpose flood prevention and recreation structure. It is located on Lower Cove Run, about 2,000 feet upstream from the town of Lost City and approximately 2,000 feet downstream from the boundary of the George Washington National Forest, at 38° 56' N latitude and 78° 50' W longitude. It is the second largest of the five structures planned for this watershed with a drainage area of 11.79 square miles. This structure has been planned to store 3,053 acre-feet or 4.22 inches of flood storage and 214 acre-feet or 0.34 inches of sediment storage. Recreation storage in the amount of 502 acre-feet has been included to provide the 50-acre recreation pool. A flood pool of 95 acres will be created during passage of the emergency spillway design storm.

In addition to flood storage, recreation storage and sediment, 397 acre-feet of storage was incorporated in the design of this dam. Adding this storage required raising the height of dam approximately 4 feet. This additional dam height will allow storage for a portion of the emergency spillway design and freeboard storms. Storing a portion of these storms reduces the amount of flow through the emergency spillway. Actual velocities in the emergency spillways during passage of the design and freeboard storms are lowered to where they meet criteria established in Soil Conservation Service Engineering Memorandum WV-6 for rock emergency spillways. Actual velocity after adding the 397 acre-feet of storage is 8.8 feet per second as compared to an allowable velocity of 8.8 feet per second for soft

shale as listed in the above memorandum.

This dam will be about 86 feet high and contain approximately 1,244,050 cubic yards of earth and rock fill. Fill material will come from the emergency spillway excavation and the flood pool above the dam. Preliminary geologic investigations indicate that material for construction of the embankment will be available within the site area. Part of this borrow will be from areas on which recreation facilities are planned. The geologic investigation was conducted using a backhoe to dig test pits to verify the type and quantity of borrow material present.

Approximately 398,000 cubic yards of earth and rock will be excavated from the left abutment of the dam to construct a 400-foot wide emergency spillway. The emergency spillway will be excavated through material classified as moderately soft to moderately hard shale. With the exception of about 49,960 cubic yards of excavation, this material should be suitable for construction of the dam.

The emergency spillway system was planned to include a concrete crest control structure that will provide protection against long duration flows resulting from passage of the freeboard hydrograph. Even though the shale and rock through which the emergency spillway is excavated is fairly resistant to erosive forces, the control structure will provide added safety against breaching of the spillway and failure of the structure. The crest control structure will require approximately 700 cubic yards of concrete for installation. This design will comply with Soil Conservation Service Engineering Memorandum-WV-6 for dams with drainage areas greater than 10 square miles.

A two-stage principal spillway consisting of a concrete riser, a 48-inch diameter concrete conduit, and concrete outlet basin was planned for this structure. Since Lower Cove Run is a good trout fishery, the riser was planned to contain provisions for releasing cold water from the reservoir to preserve this resource below the dam. The principal spillway will rest on a shale foundation and will require approximately 454 cubic yards of reinforced concrete to construct.

Installation cost of this dam is estimated to be \$1,836,200, with construction of the dam and emergency spillway expected to cost \$1,416,600, land rights \$44,200, relocation payments \$19,900, and engineering and project administration \$355,500. Installation of the dam and recreation pool will require acquisition of 225 acres of land, flooding easements on 8 acres and relocation of three home owner farmhouses and two farm operations. A Special Use Permit from the Forest Service will be required for a small acreage included within the flood pool. This will contain provisions for replacement of National Forest System Corners. The only utility relocation anticipated is the relocation of about one-quarter mile of electric lines.

Installation cost for the recreation facilities is estimated to be \$615,300, with construction expected to amount to \$487,000, land rights \$20,400, relocation payments \$8,900 and engineering and project administration \$99,000.

Recreation Facilities

The recreation development at Structure No. 16 is planned for both day and overnight use. Activities are planned at three major use areas.

Tent and trailer camping is provided in an area located on the south side of the lake. Each site will consist of a parking spur, picnic table, fireplace or grill, garbage can and rack and tent pad. One sanitary dump station is also planned to serve the area. Drinking water and sanitary facilities will be provided by two buildings located on each side of the camping area. The buildings are planned to have separate units for men and women. This area will accommodate about 280 people at one time and has adequate space available in adjacent areas for future expansion if needed. An open play area is also provided near the campgrounds for group activities and as a playground for small children. Playground apparatus will be provided. Access to the campground will be by a two-lane, 20-foot blacktop road to be constructed across the top of the dam. A one-lane, 12-foot gravel road will provide access within the area.

Two picnic areas will provide space for day-use visitors. One area accommodating about 300 people is located on a level terrace between the lake and overnight camping area. Access will be provided by a two-lane, 20-foot blacktop access road with some one-lane, 12-foot gravel road within the picnic areas. One large picnic shelter having a fireplace, concrete floor, electricity, five garbage cans and racks and 10 tables will be provided for group picnicking. Two smaller shelters, equipped with four tables, a grill at each end, concrete floor and two garbage cans and racks are planned for individual or small group use. Twenty-one picnic units are planned, each consisting of a picnic grill, garbage can and rack and two 6-foot tables. Parking will be provided by two blacktop lots accommodating about 70 cars. Two sanitary buildings separated for men and women will provide the necessary sanitary facilities.

The second picnic area is located on the north side of the lake between the dam and bathhouse and will accommodate about 140 people. A large shelter and two small shelters will provide picnicking facilities for groups. The shelters will have the same facilities as those in the previous picnic area. Five picnic units will be constructed, each consisting of a picnic grill, two 6-foot tables and a garbage can and rack. One centrally located sanitary building, separated for men and women, will serve the area. Access will be provided by a one-way, two-lane, 20-foot blacktop road to the second parking area. Two blacktop parking lots, accommodating approximately 120 cars, will provide parking for this picnic area as well as the beach area.

Swimming will be provided at a sand beach located adjacent to the picnic area on the north side of the lake. Facilities planned include three life-guard stands, two diving platforms, buoys and ropes to mark the swimming area, sand beach, six 8-foot benches and 10 garbage cans and racks. A bathhouse to include sanitary facilities for men and women is planned for installation above the beach area. A surfaced walkway will be built to

provide safe access to the sand beach. The beach is designed to accommodate about 450 people at one time. This total does not include people in the water, nor those using the grassed open area above the sand beach. An open play area with playground equipment will also be provided in this area. Access to the area will be by a one-way, 12-foot blacktop road. Investigations at the time of planning showed that the quality of water was satisfactory for swimming. No significant change is anticipated in the foreseeable future.

Located at the upper end of the lake will be a boat dock with fish cleaning facilities and a gravel parking lot for about 20 cars. Access to the area is by a controlled access one-lane, 12-foot gravel road. About 4,000 linear feet of foot trails will provide safe and easy access to the lake. The West Virginia Department of Natural Resources will provide fishery management for the impoundment.

A sewage stabilization pond is planned as the treatment method for sewage from the development. The pond will be located below the structure with lines constructed from each of the sanitary facilities. The pond will have a surface area of 1.4 acres with an average depth of 5 feet.

Low flows in Lost River will be adequate to receive and assimilate the residual waste loads from the stabilization lagoon. The 7-day, 10-year low flow for Lost River at the point where the effluent from the stabilization lagoon enters is approximately 2 cubic feet per second. Anticipated peak flows from the lagoon will be about 0.05 cubic feet per second. Therefore, the 90 percent BOD reduction in the lagoon should be satisfactory, and the nutrients will have a beneficial affect on Lost River. However, the effluent from the lagoon will be disinfected by chlorination to guard against pathogenic organisms entering the river. Monitoring of fecal coliforms will be done at least weekly during the recreation season. Samples will be taken on Lost River just downstream of the confluence with Cove Run.

Drinking water will be obtained from the lake and treated by a packaged water treatment plant. A 100,000-gallon storage tank will also be a part of the system.

Plans for sanitary waste disposal and drinking water facilities have been coordinated with the West Virginia Public Health Department and their approval received. The sponsors agree to operate and maintain the development in accordance with health and sanitation standards.

The watershed work plan has been coordinated with the West Virginia Antiquities Commission and the West Virginia Economic and Geologic Survey. Investigations indicate that installation of the project will not encroach on any known archeological values or any historic site. If artifacts or other items of archeological or historical significance are uncovered before and during construction, construction will not begin or continue until the Director, West Virginia Department of Archives and History, and the National Park Service are notified and a course of action agreed to between the Sponsors, the Service, and responsible agencies is implemented.

Should detailed investigation, salvage, or mitigation be necessary, appropriate arrangements will be made between the Sponsors, Soil Conservation Service, and U. S. Department of the Interior, National Park Service. Provisions of the Reservoir Salvage Act will be followed.

All facilities in which Federal cost-sharing is involved will be designed and constructed to assure accessibility and usability by physically handicapped people.

EXPLANATION OF INSTALLATION COSTS

Land Treatment

The costs for installation of the land treatment phases of this plan consist of landowner, National Forest, soil survey, roadbank stabilization, and technical assistance costs. These costs are based on recent costs experienced in the installation of similar measures.

Landowner application costs are estimated to be \$266,800 and include any cost-sharing assistance that may be available through the Rural Environmental Assistance Program or similar programs.

Included in the installation cost is \$3,000 for the stabilization of 10 acres of critical eroding roadbanks. This cost will be shared on a division of work basis; the Potomac Valley Soil Conservation District will be responsible for labor and equipment and the Soil Conservation Service will be responsible for the materials. The George Washington National Forest will spend \$46,400 from regular appropriations and \$18,400 from accelerated funds to provide protection and accomplish land treatment goals on National Forest land.

Technical assistance costs amount to \$135,900 and include \$13,800 from going program funds and \$122,100 from P.L. 534 funds. Included in the P.L. 534 funds are \$25,200 for soil surveys and \$96,900 for technical assistance to accelerate the rate of application of land treatment measures consistent with the objectives of the plan.

Structural Measures

Cost computations for the structural measures were made at current prices and based on calculated quantities. Unit prices were obtained from bid prices for work of a similar nature and adjusted for location, topography, and foundation conditions. A contingency allowance of 12 percent was added to the final estimate.

Costs for land rights are based on estimates made by qualified appraisers and local persons, assisted by representatives of involved agencies, as to values or costs to landowners, utility companies, State Department of Highways and others. These estimates were reviewed and concurred in by Soil Conservation Service personnel.

Costs for engineering and administrative services are based on records kept by the state office of the Soil Conservation Service, Morgantown, West Virginia. The cost of legal fees and surveys was estimated at \$8,000 for such activities as price negotiation, search of title, correspondence and recording of deeds.

1. Multiple-Purpose Structure No. 16: The Use-of-Facilities Method was used to allocate joint construction and engineering services costs in proportion to the capacity assigned to each purpose. On this basis, 85.1 percent of the joint costs was allocated to flood prevention and 14.9 percent was allocated to recreation. The costs will be shared by P.L. 534 and other funds as set forth in the agreement. Sharing of relocation payments will be discussed elsewhere. The areal method was used in allocating land at the structure.

Some of the more important items of construction relative to Structure No. 16 include \$125,100 for rock excavation, \$746,400 for embankment fill, \$105,500 for reinforced concrete and \$42,800 for seeding. Items related to construction of basic recreation facilities are shown in Table 2B.

2. Floodwater Retarding Structures: The four single-purpose floodwater retarding structures have an estimated cost of \$3,228,500 for construction and \$322,800 for engineering services, which will be borne by P.L. 534 funds. Some of the more significant items of construction, in aggregate, include embankment fills, \$1,331,800; reinforced concrete, \$427,400; and rock excavation for channel outlets and emergency spillways, \$320,200.

3. Land, Easements and Rights-of-Way: Land rights for the four single-purpose floodwater retarding structures, estimated at \$494,900, will be borne by the Sponsoring Local Organizations. Land rights costs for the multiple-purpose structure, estimated at \$64,600, will be shared by the Sponsoring Local Organizations and P.L. 534. The local share of \$34,700 amounts to more than one-half of the land rights cost due to legal fees, surveys and flood flowage easement, estimated at \$4,800, which are not cost sharable items. The P.L. 534 share of land rights costs is \$29,900. The amount of land required for structure No. 16 and water-oriented recreation in conjunction with this watershed project is limited to 225 acres. No additional acres are planned for purchase at this time.

Costs of all land rights were estimated to be \$559,500. The following is a breakdown of these costs:

Road	230,000
Utilities	35,500
Cemetery	5,000
Buildings	154,000
Flowage Easements	67,200
Land Purchase	59,800
Legal Fees and Surveys	8,000
Total	<u>\$559,500</u>

4. Relocation Payments Costs: Acquisition of land rights, in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (PL 91-646), will result in the necessity for relocation of nine owner occupied dwellings, two tenant occupied dwellings and eight farm operations. These relocations involve 33 persons.

Total costs of relocation payments were estimated to amount to \$86,300. Cost sharing will be based on the total project cost less the relocation payments, with 83.1 percent being a P.L. 534 cost and 16.9 percent being a local cost. At this ratio, the estimated P.L. 534 cost would be \$71,400 and other costs \$14,900.

5. Project Administration Costs: Project administration costs include such items as inspection, secretarial services, review of engineering plans, government representative, relocation assistance advisory services and other administration or overhead costs. The Service and Sponsors will each bear the project administration costs they incur, estimated to be \$768,200 and \$30,200, respectively. The Sponsoring Local Organizations will provide, without Federal assistance, the relocation assistance advisory service. Specific responsibilities will be discussed further under PROJECT INSTALLATION.

The estimated obligation of project funds for each fiscal year during the installation period is as follows:

Yr.	P.L. 534 (Dollars)			Other (Dollars)			
	<u>Land Treatment</u>		<u>Structural</u>	<u>Land Treatment</u>		<u>Structural</u>	DOH
	Non-Fed.	Federal		Non-Fed.	Federal		
	<u>Land</u>	<u>Land</u>		<u>Land</u>	<u>Land</u>	<u>Road Relocation</u>	
1st	15,800	7,200	0	35,200	5,800	0	0
2nd	15,400	7,200	598,100	35,200	5,800	18,900	30,000
3rd	15,400	4,000	715,500	35,200	5,800	39,100	5,000
4th	15,400	0	1,702,900	35,200	5,800	133,300	0
5th	15,400	0	318,600	35,200	5,800	296,700	0
6th	15,400	0	1,108,100	35,200	5,800	74,900	45,000
7th	15,400	0	1,694,500	35,200	5,800	149,200	150,000
8th	15,400	0	0	35,700	5,800	0	0
Total	123,600	18,400	6,137,700	282,100	46,400	712,100	230,000

EFFECTS OF WORKS OF IMPROVEMENT

The combined effects of land treatment and structural measures for flood prevention and sediment retardation will greatly reduce the major land and water resource problems throughout the watershed. These measures will (1) prevent significant damage from flooding and sediment, (2) reduce maintenance costs for roads and bridges, (3) create new job opportunities, (4) stimulate improvement of personal properties, (5) increase flood-free areas for development, (6) create a sense of community pride, and (7) provide for much needed recreational activities in the eastern part of the state. More than 342 properties will receive floodwater damage reduction benefits.

Both vegetative and mechanical types of land treatment measures are required to effectively reduce runoff, conserve moisture, and prevent excessive losses of topsoil. They will serve to eliminate erosion problems on individual farms and, at the same time, effect reductions of downstream damages through greater control of floodwaters and sediment at points of origin. Many of the land treatment measures will enable landowners to more fully utilize sound land management practices to increase efficiencies of production.

Accelerated soil surveys and other resource inventories will provide fundamental information about the physical base of the area for land use decisions. This material is basic for providing the basis for decisions concerning use, development and treatment of watershed lands. Measures for recreation and fish and wildlife will greatly benefit these resources from the standpoint of both enhancement and availability. This, in turn, will contribute materially to the quality of life in the community.

Hydrologic conditions of watershed lands will be greatly improved with the installation of land treatment measures. Infiltration and percolation rates will be increased and, in turn, will reduce erosion. Adequate fire protection and multiple use management of the forest land resources will increase the benefits from water, recreation and fish and wildlife in addition to timber production. Management of any land acquired under the U.S. Forest Service's acquisition program will further protect and enhance the forest resource.

After the land treatment and structural measures are installed, a minimum 5-year level of flood protection during the growing season will be afforded in the major evaluation flood plain reaches of Lost River. Estimated reductions in flooding during the growing season by the project from a 5-year frequency flood is 476 acres.

Based on measured project effects, the estimated average annual flood damages to crops, pastures and other agricultural improvements will be reduced by about 88 percent. A reduction of approximately 12,100 tons annually in the amount of sediment leaving the watershed is also expected due to land treatment and structural measures. Direct non-agricultural damages will be reduced by about 76 percent.

The project is expected to result in considerable savings by reducing flood and sediment damage repairs to public roads, bridges and culverts, fences and other fixed improvements. These savings will accrue to individual land and property owners, to the watershed, and the general public. Disruptions of traffic by floods will be virtually eliminated throughout the watershed. The 100-year frequency flood, with the project installed, will be approximately 2.5 feet below the first floor of the South End Grocery in Mathias. At this level, some ten existing low-lying buildings such as garages, barns and chicken houses may still be subject to flooding.

In Mathias and Baker, the damages to gardens, garages and outbuildings was considered to be an integral part of damages to dwellings. It is estimated that this category will receive \$700 in average annual damages with the project installed. Commercial properties located on the main stem in Mathias will continue to receive structural damage with the project installed. Total protection of these properties by the addition of another structure on Howard Lick Run proved to be too costly in project formulation. For this reason, further development in the lower area of Mathias is discouraged, and it is essential that the channel be kept free of debris.

Based on present population and growth trends in the area, the need for recreation facilities is evident throughout the watershed and surrounding communities. Multiple-purpose Structure No. 16 on Lower Cove Run is designed to provide 50 acres of water for recreational use. This project will provide the opportunity to develop adequate and high-quality water-related facilities.

Developments at Site No. 16 will provide facilities for such activities as fishing, boating, picnicking, swimming, camping and walking for pleasure. The adjacent George Washington National Forest provides excellent space for hunting and other outdoor activities.

The prime recreation season includes the summer months of June, July and August for water contact sports. There would be at least a six-month period for activities such as fishing, boating, walking for pleasure and picnicking. Calculated estimates of annual visits for all activities is 105,750 with a design capacity of 1,200.

The overall effects of the project on fisheries of the watershed will be beneficial. Temporary increases in sediment and turbidity will occur during project construction and 2.4 miles of stream channels and associated ecosystems will be eliminated. With completion of the project, an additional 168 acres of water surface will be created, sediment concentrations will be reduced in downstream areas, and cold water fisheries of Lost River enhanced. The West Virginia Department of Natural Resources will provide fishery management on all impoundments open to public fishing. Water in these impoundments will be suitable for spring trout fishing and for largemouth bass and bluegill fishing during the summer months.

The five structures in this project inundate mostly pastureland, very little cropland, and small areas of hardwoods. This would affect some squirrel habitat, but would not affect the huntable population. The addition of cold-water releases in two of the structures will protect the trout fishery on Kimsey Run and Lower Cove Run.

The overall effect of structural measures on wildlife habitat will be beneficial. The structures will provide clean water for waterfowl and wildlife habitat. Present vegetative conditions of the land at structure sites provide poor habitat for deer, squirrel and turkey, the major game species. Land treatment measures planned will improve food and cover conditions through controlled grazing, timber stand improvement and reforestation.

Works of improvement proposed in this Work Plan have been planned in accord with the National Historical Preservation Act of 1966. Installation of this project will not adversely affect any known archeological, historical, or scientific features. An investigation of the dam sites, conducted by the Archeology Section of the West Virginia Economic and Geologic Survey, did not reveal any archeological or historic sites. If discoveries are made during the geologic investigations or construction of structural measures, the Director, West Virginia Department of Archives and History and the National Park Service will be notified. Construction or investigations will cease until the proper arrangements have been made for salvage, protection, display, etc.

PROJECT BENEFITS

Total annual benefits from structural measures and land treatment are estimated to average \$541,400. Floodwater reduction benefits will average \$236,200 annually. At least 342 owners of existing properties will be benefited by floodwater reduction.

Local secondary benefits stemming from and induced by the project are estimated to average \$35,200 annually. This will be the result of locally stimulated marketing activities. Secondary benefits from a national viewpoint were not considered pertinent to economic justification.

Redevelopment benefits are estimated to amount to \$93,800 annually. This includes employment opportunities that will be created during installation of the works of improvement and labor for operation and maintenance. Additional employment benefits will stem from the construction and use of supplemental improvements induced by the project.

Land treatment will provide substantial aesthetic values as well as increased net farm income. The combined value of land treatment benefits is estimated at \$14,600 annually.

Five-year flood protection of 476 acres will result in more intensive use of land. A few property owners may use flood-free acreages for camp sites. Benefits estimated at \$26,400 will accrue to more intensive use of crop and pastureland and \$17,500 to commercial recreation enterprises.

The subwatershed is located above the Nation's Capitol and Potomac Estuary. It is estimated that downstream sediment reduction benefits will amount to \$79,900 annually. Some of this will accrue to metropolitan water supply, navigation, commercial fishery, sports fishery, boating and aesthetics.

The recreational development at Structure No. 16 is calculated to be complementary to the Lost River State Park, Warden Lake, Trout Pond and other existing recreational attractions. It will have a beneficial influence on the community as a whole, providing a nucleus around which many groups can become active both socially and physically. It will be a catalyst for community improvement.

The project is expected to attract out-of-state visitors due to its close proximity to large urban centers such as Washington, D.C., and Baltimore, Maryland. Visiting the mountains and open spaces may have considerably more value to these park visitors than to local residents, who sometimes take such values for granted. For the individual, each activity available will provide different experiences. The major activities which have been planned include picnicking, camping, swimming, boating, fishing and nature walks. At least 105,750 visits are expected annually and, at a value of \$1.50 per visit, the recreational benefit will amount to \$158,700 annually.

Opportunities for incidental recreation will be created along the stream and at the single-purpose flood prevention structure sites. Topography and access are excellent for incidental recreation. Public access, safety facilities and sanitary facilities are essential prior to encouraging this type of use. These developments will be discouraged if any of the above services are not provided.

COMPARISON OF BENEFITS AND COSTS

Annual benefits from structural measures total \$526,800, including secondary benefits of \$35,200. Average annual costs amount to \$423,500, producing a total benefit-cost ratio of 1.2:1.

Without secondary benefits, the ratio is 1.2:1. Table 6 shows comparison of total benefits and costs for the structural measures included in this work plan.

PROJECT INSTALLATION

The installation period for land treatment and structural measures included in this plan is eight years. Proposed order of installation for the works of improvement is as follows:

First year	- Land treatment
Second year	- Land treatment and Structure No. 27
Third year	- Land treatment and Structure No. 10
Fourth year	- Land treatment and Structure No. 16
Fifth year	- Land treatment and recreation facilities at Structure No. 16
Sixth year	- Land treatment and Structure No. 23
Seventh year	- Land treatment and Structure No. 4
Eighth year	- Land treatment

Responsibilities for installation of project measures are listed below.

Land Treatment

These measures on private land will be installed by individual landowners or operators uniformly over the 8-year installation period. The U.S. Forest Service will install the land treatment measures on the George Washington National Forest.

The Potomac Valley Soil Conservation District, in accordance with their long-range plan and objectives, has the responsibility for coordinating the land treatment program within its boundary. The district will assume a leadership role for installation of planned land treatment measures within the project period.

Technical assistance for soil surveys and planning and installing the needed land treatment measures on private land will be provided district cooperators by the Soil Conservation Service and the West Virginia Department of Natural Resources, Division of Forestry, in cooperation with the Forest Service, through the Potomac Valley Soil Conservation District. The Soil Conservation Service will develop inventories and make recommendations concerning the use of soil, water, fish and wildlife, and recreation resources. They will also provide technical and consultive assistance necessary to record land use decisions and plan and establish the measures associated with erosion control, drainage and water disposal.

The West Virginia Department of Natural Resources, Division of Forestry, in cooperation with the Forest Service, will make forest inventories and develop recommendations concerning multiple-use management of all forest resources.

The Potomac Valley Soil Conservation District will be responsible for stabilizing approximately 10 acres of critically eroding roadbanks. The district, through arrangements with the West Virginia Department of Highways, will provide equipment and labor estimated to cost \$1,500.

Structural Measures

General responsibilities for installation of structural measures are shown in the work plan agreement. Individual responsibilities are shown below:

1. Potomac Valley Soil Conservation District, with the assistance of the Lost River Watershed Association, will be responsible for obtaining land rights for the installation of Structures Nos. 4, 10, 23, and 27. The estimated cost is \$494,900.

2. The Hardy County Parks and Recreation Commission will:

- a. Be responsible for obtaining land rights for installation of Structure No. 16 and related recreation facilities. This includes a Special Use Permit from the Forest Service covering a small portion of the flood pool. The estimated cost is \$64,600, of which \$800 is for flowage easements.

b. Enter into an Engineering Services Agreement with the Service and private consultant to provide engineering services for the basic recreation facilities for Structure No. 16. The cost, estimated to be \$39,000, will be shared with the Service as shown in the work plan agreement. The Commission will provide its share of the cost through a trust fund or bank deposit agreement with the Service.

c. At the request of the Sponsors, provide construction funds for recreation facilities and Structure No. 16, as shown in the work plan agreement. The estimated cost is \$349,000.

3. The Soil Conservation Service will:

a. Provide installation funds for structural measures and basic facilities as shown in the work plan agreement.

b. Enter into an Engineering Services Agreement with the Hardy County Parks and Recreation Commission and private consultant to provide engineering services for the basic recreational facilities on Structure No. 16. The cost, estimated to be \$39,000, will be shared with the Commission as shown in the work plan agreement. The Service will assume leadership and contract for these services.

c. Provide contract administration services for all structural measures and basic recreation facilities at Structure No. 16.

The Soil Conservation Service and Sponsoring Local Organizations will each bear the project administration costs they incur. The total amount for the project is estimated to be \$798,400. Legal adequacy of land purchase, easements and permits will be determined by the Sponsoring Local Organizations with the stated responsibility.

Each Sponsoring Local Organization has the authority under applicable State law to exercise the right of eminent domain to acquire land rights including relocations or modifications of existing improvements. The Sponsors agree to use this right, if necessary.

As a part of project administration, the Sponsors will provide such relocation assistance advisory services as may be needed in connection with the relocation of displaced persons and farm operations. In connection with the single-purpose structures, the Potomac Valley Soil Conservation District, with the assistance of the Lost River Watershed Association, will: (1) provide personally or by first class mail, written notice of relocations and appropriate application forms to each displaced person, business or farm operation at least 90 days before they are required to move, (2) assist in filing applications, (3) review and approve applications for relocations assistance, (4) review and process grievances in connection with relocations, and (5) make relocation payments.

The Hardy County Court and Parks and Recreation Commission will perform these functions for the multiple-purpose structure and recreational development. The Service, as a part of project administration, will assist the District, the Association and the Commission in fulfilling their responsibilities.

Through surveys, the Sponsors have determined that comparable decent, safe and sanitary replacement housing will be available for all persons subject to displacement by the project from housing expected to be available on the market through normal turnover and through expected construction.

FINANCING PROJECT INSTALLATION

Land Treatment

Owners and operators of watershed lands will install land treatment measures at their expense utilizing cost sharing assistance available through the Rural Environmental Assistance Program.

The Soil Conservation Service will use \$6,300 from its going program funds and the Forestry Division, West Virginia Department of Natural Resources, will use \$7,500 from its regular funds, including cooperative forestry programs with the U.S. Forest Service, for continuing the rate of technical assistance currently available. Protection from fire and pests will be provided by the West Virginia Forestry Division and the West Virginia Department of Agriculture through going cooperative forestry programs and will cost \$63,900.

A total of \$122,100 will be provided by P.L. 534 for accelerated technical assistance. Of this amount, \$79,000 will be allocated to the Soil Conservation Service for completion of soil surveys and additional technical assistance to landowners. The remaining \$43,100 will be allocated to the Forest Service to provide accelerated technical assistance to forest landowners. This accelerated assistance will be provided by the Forestry Division of the West Virginia Department of Natural Resources.

Total cost for revegetating critical areas on roadbanks is estimated to be \$3,000. Of this amount, P.L. 534 will pay the cost of materials, and the cost of labor and equipment will be borne by the Potomac Valley Soil Conservation District. The District expects to finance its share through arrangements with the West Virginia Department of Highways.

The Forest Service will provide \$46,400 from regular Forest Service appropriations for protection and the installation of land treatment measures on the George Washington National Forest as such funds are made available for this purpose. An additional \$18,400 will be provided under P.L. 534 for installation of an accelerated erosion control program on the National Forest.

Structural Measures

The Potomac Valley Soil Conservation District, representing the Lost River Watershed Association, will finance the land rights and the local share of relocation payments costs for Structures Nos. 4, 10, 23, and 27 as follows:

1. It is expected that easements will be donated on a large portion of the land needed.

2. The State of West Virginia, through the State Department of Agriculture and State Soil Conservation Committee, has assisted local Sponsors on watersheds throughout the State. Their assistance on land rights costs is anticipated.

3. It is anticipated that the West Virginia State Department of Highways will assist with the cost of road relocations.

4. Utility companies are expected to cooperate in the subwatershed in relocating their facilities as they have on other watersheds.

5. Local contributions from property owners in the watershed are expected to assist with these costs. The Lost River Watershed Association will conduct fund-raising campaigns as needed.

The Hardy County Parks and Recreation Commission, as an arm of the Hardy County Court, will finance its share of Structure No. 16 and related recreation facilities by a watershed loan from the Farmers Home Administration. A letter of intent concerning the loan has been filed with that agency.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment

Land treatment measures on private land will be maintained by landowners or operators under agreement with the Potomac Valley Soil Conservation District. Technical assistance for maintenance of land treatment measures will be furnished landowners and operators as it is available from cooperating agencies. The U.S. Forest Service will maintain land treatment measures on George Washington National Forest Land.

Roadbanks stabilized under this plan will be the responsibility of the Potomac Valley Soil Conservation District. These areas consist of 10 acres of actively eroding roadbanks. Maintenance will consist of weed control and treatment required to maintain a good vegetative cover. The districts anticipate that operation and maintenance agreements will be reached with the State Department of Highways for performance of this work.

Structural Measures

The Potomac Valley Soil Conservation District will be responsible for operation and maintenance of Structures Nos. 4, 10, 23, and 27. This cost is estimated to be \$2,100 annually, and is an adjusted current normalized cost, taking into account future trends. It is anticipated that this work will be performed by the West Virginia Department of Highways. Some of the more common maintenance items on these structures will be as follows:

1. Repair eroded areas and small slides in the vicinity of the earth embankment and emergency spillway.
2. Clean trash racks and remove floating debris.
3. Mow dam and emergency spillway area each year.
4. Seed and mulch bare areas which may occur after the established period.
5. Topdress the fill and emergency spillway with lime and fertilizer as needed.
6. Repair riprap and concrete as needed.
7. Clean stilling basin and outlet channel as needed.
8. Maintain fences.
9. Keep a record of operation and maintenance costs.

Normal maintenance and operation of the multiple-purpose structure at Site No. 16 will be the responsibility of the Hardy County Parks and Recreation Commission. Estimated average annual operation and maintenance costs of this structure and the recreational development is \$30,200. This cost consists of an estimated \$500 annually for the maintenance of the dam and emergency spillway and reservoir area and \$29,700 annually to cover replacement costs of recreational facilities, salaries of operating personnel, sanitation, and safety in the recreation complex.

Common items of maintenance for the multiple-purpose dam will be the same as those listed for the single-purpose structures. Some of the more basic items of operation for the recreational development will be as follows:

1. Regulating the number of users to insure that overuse does not diminish aesthetic value of the environment.
2. Confining travel of motor vehicles to designated areas and controlling speed.
3. Keeping each recreational facility clean and sanitary.
4. Disposing of garbage and other refuse as often as necessary.
5. Eliminating and minimizing safety hazards such as dangerous trees and toxic plants.
6. Providing for chlorination of the lagoon effluent during the recreation season.
7. Monitoring fecal coliforms at least once a week on Lost River just downstream of the confluence with Cove Run.
8. Providing a full-time caretaker and seasonal help.
9. Maintaining a record of operation and maintenance costs and recreation use.

Some of the more common maintenance items include:

1. Reseeding areas to eliminate erosion.
2. Maintaining vigorous grass growth with fertilizers.
3. Mowing grass when needed.
4. Servicing and maintaining facilities such as toilets, boat docks and picnic tables and grills on a regular basis.
5. Managing excessive aquatic weed growth and eutrophication problems in the reservoir with consultation from West Virginia Department of Natural Resources.

In addition to the above items, the West Virginia Department of Natural Resources, Division of Wildlife Resources, will provide fishery management for multiple-purpose dam 16. This management will include stocking, annual population survey, restocking or removal as needed, and possible fertilization or other management indicated by past impoundment studies.

Structural works of improvement proposed in this plan will be jointly inspected for the first 3 years by concerned Sponsoring Local Organizations and representatives of the Soil Conservation Service. These inspections will be made annually and also after every major storm or other occurrence that might adversely affect the structures. Inspections after the third year will be made annually by the Sponsors. The Sponsors will furnish the Service a written report of each inspection.

Specific maintenance agreements will be entered into between the Sponsoring Local Organizations and the Soil Conservation Service prior to signing land rights or project agreements. These agreements will give detailed requirements for operation and maintenance, inspection, records and reports.

Campsites and all other types of residential development will be discouraged on land below the 100-year flood elevation. Flood plain maps showing the elevation of the 5-year frequency flood and the 100-year frequency flood will be made available to local Sponsors. The Hardy County Court will make every reasonable effort to develop means of keeping land use in the flood plain commensurate with the protection provided. The Court will seek the development of zoning ordinances and building codes, and annually publish in local newspapers flood plain maps showing those areas still subject to flooding from a 100-year flood.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST

Lost River Watershed, West Virginia

	:	:	:	:	:	Estimated Cost (Dollars)1/											
						Unit	:	:	:	:	:	P.L. 534 Funds			Other		
												Fed. Land	Non-Fed. Land	Total	Fed. Land	Non-Fed. Land	Total
LAND TREATMENT																	
Soil Conservation Service																	
Cropland	Ac.	--	1,400	1,400	--	--	--	--	--	--	--	52,800	52,800		52,800		
Grassland	Ac.	--	7,000	7,000	--	--	--	--	--	--	--	113,700	113,700		113,700		
Miscellaneous Land	Ac.	--	25	25	--	--	--	--	--	--	--	800	800		800		
Critical Area	Ac.	--	25	25	--	--	1,500	1,500	--	--	--	6,000	6,000		7,500		
Technical Assistance	--	--	--	--	--	--	79,000	79,000	--	--	--	6,300	6,300		85,300		
SCS Subtotal	--	--	8,450	8,450	--	--	80,500	80,500	--	--	--	179,600	179,600		260,100		
Forest Service																	
Forest Land	Ac.	12,100	74,200	86,3002/	18,400	--	--	--	18,400	46,400	--	95,000	141,400		159,800		
Technical Assistance	--	--	--	--	--	--	43,100	43,100	--	--	--	7,500	7,500		50,600		
FS Subtotal	--	12,100	74,200	86,300	18,400	--	43,100	61,500	46,400	102,500	148,900				210,400		
TOTAL LAND TREATMENT	--	12,100	82,650	94,750	18,400	--	123,600	142,000	46,400	282,100	328,500				470,500		
STRUCTURAL MEASURES																	
Soil Conservation Service																	
Construction	No.	--	4	4	--	--	3,228,500	3,228,500	--	--	--	--	--		3,228,500		
Floodwater Retarding Strs.	No.	--	1	1	--	--	1,311,100	1,311,100	--	--	--	105,500	105,500		1,416,600		
Multiple-Purpose Structure	--	--	--	--	--	--	243,500	243,500	--	--	--	243,500	243,500		487,000		
Recreation Facilities	--	--	--	--	--	--	4,783,100	4,783,100	--	--	--	349,000	349,000		5,132,100		
Subtotal Construction	--	--	--	--	--	--	484,000	484,000	--	--	--	19,500	19,500		503,500		
Engineering Services	--	--	--	--	--	--	484,000	484,000	--	--	--	19,500	19,500		503,500		
Subtotal Engineering	--	--	--	--	--	--	71,400	71,400	--	--	--	14,900	14,900		86,300		
Relocation Payments	No.	--	17	17	--	--	71,400	71,400	--	--	--	14,900	14,900		86,300		
Subtotal Relocations	No.	--	17	17	--	--	71,400	71,400	--	--	--	14,900	14,900		86,300		
Project Administration																	
Relocation Assistance Advisory Service	--	--	--	--	--	--	0	0	--	--	--	5,000	5,000		5,000		
Construction Inspection	--	--	--	--	--	--	600,100	600,100	--	--	--	20,000	20,000		620,100		
Other	--	--	--	--	--	--	167,100	167,100	--	--	--	5,200	5,200		173,300		
Review of Contracts	--	--	--	--	--	--	1,000	1,000	--	--	--	--	--		1,0003/		
Subtotal Administration	--	--	--	--	--	--	768,200	768,200	--	--	--	30,200	30,200		798,400		
Other Costs																	
Land Rights	--	--	--	--	--	--	29,900	29,900	--	--	--	529,600	529,600		559,500		
Subtotal Other	--	--	--	--	--	--	29,900	29,900	--	--	--	529,600	529,600		559,500		
TOTAL STRUCTURAL MEASURES	--	--	--	--	--	--	6,136,600	6,136,600	--	--	--	943,200	943,200		7,079,800		
TOTAL PROJECT																	
Summary	--	2,255	20,000	22,255	18,400	--	6,260,200	6,278,600	46,400	1,225,300	1,271,700				7,550,300		
Subtotal SCS	--	0	8,450	8,450	0	--	6,217,100	6,217,100	0	1,122,800	1,122,800				7,339,900		
Subtotal FS	--	12,100	74,200	86,300	18,400	--	43,100	61,500	46,400	102,500	148,900				210,400		
TOTAL PROJECT	--	12,100	82,650	94,750	18,400	--	6,260,200	6,278,600	46,400	1,225,300	1,271,700				7,550,300		

1/ Price Base - 1973

2/ A total of 86,300 acres forest land will receive protection from the Cooperative Forest Fire and Pest Control Program. Of this total, forest management will be applied to 15,800 acres.

3/ For engineering A & E contracts.

October 1974

TABLE 1A - STATUS OF SUBWATERSHED WORKS OF IMPROVEMENT

Lost River Subwatershed, West Virginia

Measures	Unit	Applied to date <u>1/</u>	Total Cost (Dollars) <u>2/</u>
<u>LAND TREATMENT - SCS</u>			
Conservation Cropping System	Ac.	1,479	29,580
Strip Cropping, Contour	Ac.	230	920
Diversion	Ft.	9,825	1,965
Grassed Waterway or Outlet	Ac.	4.3	860
Tile Drain	Ft.	120,356	30,089
Pasture & Hayland Management	Ac.	10,696	168,833
Pasture & Hayland Planting	Ac.	1,202	60,100
Farm Pond	No.	61	30,500
Critical Area Planting	Ac.	2	400
Contour Farming	Ac.	234	936
Brush and Weed Control	Ac.	140	1,400
Land Clearing	Ac.	15	1,500
Stream Channel Improvement	Ft.	35,550	8,520
Trough	No.	33	2,640
Spring Development	No.	23	2,300
Mains and Laterals	Ft.	58,371	17,511
SCS Subtotal	--	--	358,054
<u>LAND TREATMENT - FS</u>			
Tree Planting	Ac.	197	7,600
Hydrologic Stand Improvement	Ac.	2,890	24,000
Management Plans	Ac.	2,300	1,800
Rehabilitation of Abandoned Roads and Trails	Mi.	20	1,000
Rehabilitation of System Roads and Trails	Mi.	20	5,000
Fire and Pest Control	Ac.	86,300	89,600
FS Subtotal	--	--	129,000

1/ 10-year period (1960-1969)

2/ Price Base - 1973

October 1974

TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION

Lost River Watershed, West Virginia

(Dollars) 1/

Item	Installation Cost - P.L. 534 Funds				Installation Cost - Other Funds				Total	
	Construc- tion	Engi- neering	Land Rights	Reloca- tion Pay ments2/ P.L. 534	Total Construc- tion	Engi- neering	Land Rights	Reloca- tion Pay ments2/ P.L. 534	Total	Installa- tion
Floodwater Re- tarding Strs.										
No. 4	1,329,500	132,900	0	19,100	1,481,500	0	0	291,600	4,000	295,600
No. 10	562,000	56,200	0	7,300	625,500	0	0	41,200	1,500	42,700
No. 23	862,400	86,200	0	21,200	969,800	0	0	113,700	4,400	118,100
No. 27	474,600	47,500	0	0	522,100	0	0	48,400	0	48,400
Subtotal Single- Purpose Structures	3,228,500	322,800	0	47,600	3,598,900	0	0	494,9003/	9,900	504,800
Multiple-Purpose Str. No. 16	1,311,100	141,700	20,700	16,500	1,490,000	105,500	0	23,5004/	3,400	132,400
Recreation Facilities	243,500	19,500	9,200	7,300	279,500	243,500	19,500	11,2005/	1,600	275,800
Subtotal Multiple- Purpose Structure	1,554,600	161,200	29,900	23,800	1,769,500	349,000	19,500	34,700	5,000	408,200
Subtotal	4,783,100	484,000	29,900	71,400	5,368,400	349,000	19,500	529,600	14,900	913,000
All Structures	4,783,100	484,000	29,900	71,400	5,368,400	349,000	19,500	529,600	14,900	913,000
Project Administration	--	--	--	--	768,200	--	--	--	--	30,200
GRAND TOTAL	4,783,100	484,000	29,900	71,400	6,136,600	349,000	19,500	529,600	14,900	943,200

1/ Price Base 1973.

2/ Relocation payments for displacements prior to July 1, 1973, will be shared as provided in PL 91-646 and in paragraph numbered 2 of agreement.

3/ Includes \$4,000 for surveys and legal fees; \$404,700 for modifications of facilities.

4/ Includes \$2,000 for surveys and legal fees; \$19,000 for modifications of facilities and \$800 for flowage easements.

5/ Includes \$2,000 for surveys and legal fees; \$800 for modification of facilities.

TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Lost River Watershed, West Virginia

(Dollars) 1/

Item	COST ALLOCATION			COST SHARING					
	:	:	:	:	:	:	:	:	:
	Flood Prevention	Recreation	Total	P.L. 534 Flood Prevention	Recreation	Total	Flood Prevention	Recreation	Other Funds
Single-Purpose Strs. No. 4, 10, 23 and 27	4,103,700	0	4,103,700	3,598,900	0	3,588,900	504,800	0	504,800
Multiple-Purpose Str. No. 16	1,327,000	295,400	1,622,400	1,326,200	163,800	1,490,000	800	131,600	132,400
Recreational Facilities	0	555,300	555,300	0	279,500	279,500	0	275,800	275,800
GRAND TOTAL	5,430,700	850,700	6,281,400	4,925,100	443,300	5,368,400	505,600	407,400	913,000

1/ Price base 1973.

October 1974

TABLE 2B - RECREATION FACILITIES

ESTIMATED CONSTRUCTION COSTS

Lost River Subwatershed, West Virginia

(Dollars) 1/

Structure No. 16

	:	:	Estimated	:	Estimated	
	:	No. of	:	Unit	:	Total
Item Description	:	Units	:	Cost	:	Cost

Picnic Areas

Picnic table, 6-foot	88 ea.	80	7,040
Charcoal grill	34 ea.	100	3,400
Garbage can racks	40 ea.	50	2,000
Site preparation and seeding	8 ac.	300	2,400
Shelter--large	2 ea.	8,500	17,000
Shelter--small	4 ea.	4,500	18,000

Tent and Trailer Camp Area

Fireplace	70 ea.	100	7,000
Garbage can racks	70 ea.	50	3,500
Picnic tables, 8-foot	70 ea.	100	7,000
Trailer sanitary dump station	1 ea.	1,000	1,000

Beach and Swimming Area

Beach development			
Above water (1' sand blanket)	5,000 sq. yd.	4	20,000
Below water (1' sand blanket to 5' depth)	2,500 sq. yd.	4	10,000
Site preparation and seeding (above sand)	.5 ac.	600	300
Diving Platform (12' x 12')	2 ea.	1,000	2,000
Life Guard Stations	3 ea.	100	300
Garbage can racks	10 ea.	50	500
Benches (8-foot)	6 ea.	60	360
Bath house (equipped)	1 ea.	36,000	36,000

Structure No. 16 (Continued)

Item Description	No. of Units	Estimated Unit Cost	Estimated Total Cost
------------------	-----------------	---------------------------	----------------------------

Boating Areas

Boat dock (8 x 48)	1 ea.	1,800	1,800
Garbage can rack	2 ea.	50	100
Fish cleaning facility	1 ea.	200	200

Supporting Facilities

Parking Areas

Two lots on north side- 120 cars - blacktop	4,000 sq. yd.	5	20,000
One lot near boat dock 20 cars - gravel	670 sq. yd.	2	1,340
Two lots on south side- about 70 cars - blacktop	2,330 sq. yd.	5	11,650

Access Roads

Two-lane, 20-foot tread width - blacktop	3,200 lin. ft.	10	32,000
Culverts and Guard Rails	1 job	18,000	18,000
One-lane, 12-foot - gravel	1,600 lin. ft.	5	8,000
Parking spurs	3,500 lin. ft.	2	7,000

Sanitary Facilities

Picnic area buildings	3 ea.	10,000	30,000
Camping area buildings	2 ea.	14,500	29,000

Sewage Treatment

One system	1 job	67,000	67,000
------------	-------	--------	--------

Water Supply

One system	1 job	93,000	93,000
------------	-------	--------	--------

Structure No. 16 (Continued)

	:	:	Estimated	:	Estimated	
	:	No. of	:	Unit	:	Total
Item Description	:	Units	:	Cost	:	Cost
<hr/>						
<u>Miscellaneous</u>						
Foot trails		4,000 lin. ft.		1.50		6,000
Entrance control building		1 ea.		500		500
Signs and markers						
Entrance		2 ea.		500		1,000
Directional		Job		110		110
Foot bridge		1 ea.		5,000		5,000
Playground Apparatus		Job		5,000		5,000
Landscaping		5 ac.		300		1,500
Miscellaneous Safety Posts		Job		2,000		2,000
Electric Utilities		Job		9,000		<u>9,000</u>
TOTAL						\$487,000

1/ Price base - 1973

October 1974

TABLE 3 - STRUCTURE DATA

FLOODWATER RETARDING STRUCTURES

Lost River Subwatershed, West Virginia

Item	:	:	:	:	4	10	16	23	27	Total
	:	:	:	:	Unit					
Class of Structure					Sq. Mi.	c	c	c	c	XXX
Drainage Area					72	71	72	71	70	64.75
Curve No. (1-day) (AMC II)					4.67	1.40	1.58	2.30	1.48	XXX
T _c					1482.2	1619.2	1583.0	1849.1	1956.4	XXX
Elevation Top of Dam					1469.3	1608.4	1571.0	1834.7	1945.8	XXX
Elevation Crest of ESW					1438.4	1586.0	1541.2	1807.2	1922.8	XXX
Elevation Crest of Riser					100.0	78.0	86.0	92.0	73.0	XXX
Maximum Height of Dam					1,020,150	330,550	1,244,050	475,760	307,030	3,377,540
Volume of Fill					7825	1652	3769	2460	813	16,319
Total Capacity					605	202	198	312	60	1,377
Sediment Submerged 100 Years					48	16	16	25	5	110
Sediment Aerated					--	--	502	--	--	502
Retardation					1739	357	629	531	198	3,454
Between High and Low Stages					6972	1434	3053 ^{3/}	2123	748	14,330
Retarding										
Surface Area					70.0	18.5	25.0	22.8	6.5	142.8
Sediment Pool 1/					--	--	50.0	--	--	50.0
Recreation Pool 2/					214.0	65.5	95.0	75.0	35.5	485.0
Retarding Pool 2/										
Principal Spillway										
Rainfall Volume (areal) (1-day)					6.48	6.75	6.75	6.75	6.75	XXX
Rainfall Volume (areal) (10-day)					11.00	11.30	11.30	11.30	11.30	XXX
Runoff Volume (10-day)					6.28	6.55	6.55	6.55	6.26	XXX
Capacity High Stage (Max.)					894	321	459	445	210	XXX
Capacity Low Stage (Max.)					500	102	162	154	51	XXX
Frequency of Operation - ESW					1	1	1	1	1	XXX
Size of Conduit					Twin 48	42	48	48	36	XXX
Emergency Spillway										
Rainfall Volume (ESH) (areal)					9.8	10.9	10.7	10.9	10.9	XXX
Runoff Volume (ESH)					6.31	7.18	7.13	7.18	7.04	XXX
Type					Rock	Earth	Earth	Rock	Earth	XXX
Bottom Width					500	300	400	200	160	XXX
Velocity of Flow (Ve)					9.42	8.65	8.80	10.70	8.70	XXX
Slope of Exit Channel					0.02	0.02	0.02	0.02	0.02	XXX
Max. Water Surface Elevation					1472.9	1611.8	1574.5	1841.5	1949.2	XXX
Freeboard										
Rainfall Volume (FH) (areal)					24.15	26.80	26.26	26.80	26.80	XXX
Runoff Volume (FH)					20.08	22.45	22.14	22.45	22.26	XXX
Maximum Water Surface Elevation					1482.2	1619.2	1583.0	1849.1	1956.4	XXX
Capacity Equivalents (Total)					4.39	4.63	5.38	4.64	4.14	XXX
Sediment Volume					0.33	0.61	0.34	0.64	0.37	XXX
Retarding Volume					4.01	4.02	4.22	4.00	3.77	XXX
Recreation Volume					--	--	0.82	--	--	XXX

1/ Based on storing 100-year submerged sediment accumulation.

2/ Surface area at emergency spillway crest.

3/ Includes 397 acre-feet of design storage.

TABLE 4 - ANNUAL COST

Lost River Watershed, West Virginia

(Dollars) 1/

Evaluation Unit	: : Amortization of : Installation Cost <u>2/</u>	: : Operation and : Maintenance Cost	: : Total
All Structural Measures	347,100	32,300	379,400
Project Administration	44,100	--	44,100
GRAND TOTAL	391,200	32,300 <u>3/</u>	423,500

1/ Price base: Installation 1973, O&M 1969 adjusted current normalized.

2/ 100 years @ 5-1/2 percent interest.

3/ Includes \$30,200 for operation, maintenance, and replacement for the recreational development.

October 1974

TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Lost River Watershed, West Virginia

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage
	Without	:	Reduction
	Project	With Project	Benefit
Floodwater (On-Site)			
Road and Bridge	18,700	4,800	13,900
Other Agriculture	27,400	5,100	22,300
Dwellings	28,000	700	27,300
Commercial	13,300	7,700	5,600
Streambank	20,800	8,400	12,400
Crop and Pasture	30,800	2,100	28,700
Sediment	4,800	1,500	3,300
Erosion	8,100	3,600	4,500
Subtotal - (On-Site)	151,900	33,900	118,000
Indirect	12,100	3,400	8,700
Total (On-Site)	164,000	37,300	126,700
Floodwater (Downstream)			
Upper Cacapon flood- plain properties	88,000	68,200	19,800
Sediment	217,400	137,500	79,900
Subtotal - (Downstream)	305,400	205,700	99,700
Indirect	30,400	20,600	9,800
Total (Downstream)	335,800	226,300	109,500
TOTAL (On-Site & Downstream)	499,800	263,600	236,200

1/ Price base 1973

TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Lost River Watershed, West Virginia

(Dollars) $\frac{1}{}$

Evaluation Unit	AVERAGE ANNUAL BENEFITS									
	Damage		: Changed Land:		: Use		: Recreation		: Secondary: development	
	: Reduction		2/		: Non-Agricult.		: Recreation		: Secondary: development	
	: Reduction		: Non-Agricult.		: Recreation		: Recreation		: Secondary: development	
All Structural Measures	221,600	17,500	158,700	35,200	93,800	526,800	379,400	1.4:1		
Project Administration	--	--	--	--	--	--	44,100	--		
GRAND TOTAL	221,600	17,500	158,700	35,200	93,800	526,800	423,500	1.2:1		

1/ Price base 1973 for costs; adjusted current normalized for benefits.

2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of \$14,600 annually.

3/ From Table 4.

October 1974

INVESTIGATIONS AND ANALYSES

Land Treatment

Present land use in the watershed was determined from measurement of aerial photographs. These records were updated by Soil Conservation Service field office personnel.

Projected land use is based on good land management considering land capability, intentions of local landowners and obvious trends in land use as recognized by the Potomac Valley Soil Conservation District and agricultural workers concerned with the watershed area.

Field office and area office personnel of the Soil Conservation Service, U.S. Forest Service, the Potomac Valley Soil Conservation District, and the Division of Forestry of the West Virginia Department of Natural Resources participated in the development of land treatment measures. These measures were determined from the total needs that will result from anticipated land use changes. Consideration was given to the usual good cooperation of landowners in the watershed and also to length of installation period in arriving at the quantity of each type of practice included.

Information on the hydrologic condition of the forest land in the watershed and the reasons for the present hydrologic condition were obtained by the U.S. Forest Service in a series of systematically selected field plots. This information formed the basis for developing the precipitation-runoff curve numbers and land treatment needs for the forest land. The data obtained included measurements of the litter and humus layers, determination of soil type and other hydrologic factors. It also included recording the presence or absence of disturbance factors such as fire, grazing, cutting, logging and the abnormal infestation of insects or disease which might adversely affect the hydrologic condition or increase the fire hazard.

Forest fire protection is provided on private land by the West Virginia Department of Natural Resources in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Fire Control Program. The U.S. Forest Service provides protection on George Washington National Forest Lands. This protection is considered adequate at the present time. The average annual burn is about 0.1 percent of the forested area protected. The fire loss index goal for the watershed is 0.2 percent. No appreciable increase is anticipated in fire occurrence or area burned as a result of construction activities or tree planting. Adequacy of the fire protection effort is under continuing review by the George Washington National Forest and West Virginia Department of Natural Resources, Division of Forestry.

Economic Investigations

Individual damage schedules by personal interview were completed for agricultural properties, transportation facilities, businesses, utilities and rural and urban dwellings. These schedules contained information as to physical losses, land values and land use changes. The flood of October 1954 was considered as the base or key flood. Damage summaries were tabulated by stages and adjusted to normalized prices using indexes of "Interim Price Standards for Planning and Evaluating Water and Land Resources," Water Resources Council, April 1966.

Flood damages for all properties were computed for "with" and "without" the project using the frequency-damage relationships method as described in Chapter 3 of the Economics Guide, Soil Conservation Service, March 1964. The Economics 2 data processing program for IBM 1130 computer was used to process average annual damages for crop and pasture. Adjustments were made to include future conditions and higher damageable values. Physical damage by overwash and scour were determined by the geologist. This was converted to monetary damages in terms of reduced productivity of the soils affected. Benefits were counted in terms of restored use with the project.

Land use and cropping patterns for "with" and "without" the project were determined from field observations and interviews with flood plain farmers and professional technicians. Flood plain land use and crop yields have been restricted by frequent flooding.

Benefits from restoration to former productivity of cropland and changed land use to non-agriculture were computed in accordance with Chapter 4 of the Economics Guide.

Damages and benefits for the Upper Cacapon downstream area were measured by the methods mentioned in the first two paragraphs of the economics investigations write-up.

Downstream sediment damages and benefits were determined by using procedures developed by the Soil Conservation Service. Annual sediment load reduction was determined by the geologist and converted to monetary benefits by the economist. Extensive use was made of Dow Chemical Company's "An Economic Analysis of Erosion and Sediment Control Methods for Watersheds Undergoing Urbanization C-1677," pp. 134-143, February 15, 1971-February 14, 1972, Contract No. 14-31-000103392.

Dow Chemical Company estimated damage to be \$6.53 per ton of sediment - itemized as follows:

Metro Water Supply	\$0.31
Dredging	.67
Commercial Fishing	1.27
Sports Fishing	.88
Boating	.84
Aesthetics	2.56
Total	<u>\$6.53</u>

Researchers used assumptions and shadow costs to arrive at the above figures. Consequently, damage per ton of sediment to navigation was used as a proxy, applicable to the total tons of sediment leaving the watershed. This amounted to only \$3.00 per ton, based on information which pre-dated the Dow Chemical Report.

Recreation benefits were based on a study of the population within the zone of influence, and the corresponding supply of and demand for water-based facilities. Visits expected annually are estimated to total 105,750. A value of \$1.50 per visit was used in estimating the total annual recreation benefit of \$158,700.

Redevelopment benefits in accordance with Chapter 12 of the Economics Guide were counted. This amounts to 30 percent of construction cost and 50 percent of operation and maintenance cost limited to 20 years. Both were converted to an annual figure.

Secondary benefits stemming from, and induced by, the project were counted in terms of the percentage suggested by the Economics Guide.

Installation cost of structural measures was amortized at 5-1/2 percent interest for the life of the project. Cost of multiple-purpose Structure No. 16 was allocated to purpose by "use-of-facilities" method of cost allocation, with 85.1 percent allocated to flood prevention and 14.9 percent allocated to recreation. All installation costs are based on current prices. Operation and maintenance costs are current for the recreation complex and 1970 adjusted current normalized for Structures Nos. 4, 10, 23, and 27.

Engineering Investigations

Investigation of structural measures included the analyses of 30 floodwater retarding dams, channel improvement and diking of the channel at various locations. These measures were studied to determine their potential for preventing floods, reducing erosion and sediment scour, providing recreation and for improving fish and wildlife resources throughout the watershed area. After studying various alternate combinations of these structures and their effect on watershed problems, it was determined that four floodwater retarding structures and one multiple-purpose structure would be the most economical system to meet local objectives. Location of these measures are shown on the project map. Other measures investigated contributed little to the protection of the damage area while involving high construction and relocation costs. Table 2 lists the cost of each measure and Table 3 lists design dimensions and capacities.

Criteria established by Engineering Memorandums SCS-27 and WV-6 were used in developing preliminary designs for the five retarding structures. In accordance with this criteria, each structure was assigned a "high hazard" classification after considering the damage that might occur to existing and future developments downstream should a sudden breach of the earth embankments occur.

Topographic maps were drawn by the SCS Cartographic Unit using photogrammetric methods. The aerial photographs used in stereoplotting of the maps were taken at an altitude of approximately 6,000 feet above sea level and the topographic site maps were drawn to a scale of 1"=200' horizontally with a 5-foot contour interval. Horizontal ground control was established by a transit chained traverse, while the vertical control was taken from United States Coast and Geodetic bench marks. Stage-area relationships were developed by planimetering the area bounded by contours above the dam. Stage-storage volumes were then computed using the average-end-area method.

Hydraulic design routings were made using the IBM 1130 computer program at the Technical Service Center, Upper Darby, Pennsylvania. Each structure was designed with a two-stage principal spillway system composed of a drop inlet riser, a reinforced concrete pipe, and a concrete outlet basin resting on a shale or sandstone foundation. The crest of the orifice was set at the elevation of the sediment pool created by storing the 100-year sediment accumulation, and the riser crest was established by storing 1-inch of watershed runoff between the high and low stage. Net flood storage was determined by routing the principal spillway storm through the structure. The crest of the emergency spillway was set to store the net flood storage, sediment and accumulation and beneficial storage (Structure No. 16 only). Elevation of the design storm was established by routing the emergency spillway design storm through the structures. Discharge through the emergency spillway was designed within allowable velocity limits based upon the type of material present. Top of dam elevation was set by routing the freeboard design storm through the structures. Final proportioning was accomplished by comparing cost of emergency spillway excavation, embankment cost and land rights cost. The emergency spillway crest on Site No. 16 was raised approximately 6 feet, which resulted in a more adequate design and a less expensive structure.

The embankments of the dams were planned with 3:1 upstream side slopes and 2-1/2:1 downstream side slopes. Top width of the dam was determined using the formula $W = \frac{H + 35}{5}$, where H is the height of the dam.

Embankment volumes were computed using the center height average-end-area method. Material for construction of the embankments is readily available within the site area. It is anticipated that most of this material will come from the emergency spillway excavation and from the sediment and flood pool areas above the dams.

Rock excavation is anticipated during construction of the emergency spillway on each dam. Cross-sections of the emergency spillways were plotted and volumes of rock excavation computed using the average-end-area method.

Structures Nos. 4 and 16 were planned to include a cold-water release gate to comply with requirements of the Fish and Wildlife Service.

Construction cost estimates were based on computed quantities of all cost items with an allowance of 12 percent for contingencies. Unit prices were developed from a study of similar projects in the past in West Virginia and other northeast states.

An investigation to determine the necessary land rights and relocation costs required for construction of the five structures was made by the local watershed association easement committee and utility companies that had facilities affected by the structures. This investigation was reviewed and accepted by the Service.

Prior to construction of the dams, further geologic investigations will be necessary to better establish characteristics of construction materials and conditions of the foundation and emergency spillways. Final structural designs will be completed during the operation phase of this project.

Hydrologic and Hydraulic Investigations

Lost River Subwatershed of the Potomac River (117,220 acres or 183 square miles) has a dendritic type drainage pattern with a length-width ratio of approximately 3.0:1.0.

There is no stream gage in this watershed. Rainfall data was obtained from U.S. Weather Bureau Technical Paper No. 40 (TP-40) and the McNeill, Wardensville, Petersburg and Mathias U.S. Weather Bureau gages.

Soils and cover data were developed from soils maps and conservation needs inventory, with assistance from the district conservationist for Hardy County. Changes in land use data were updated by field observations.

Several combinations of structures were considered during the project formulation. Structures were eliminated on the basis of cost versus benefits provided, along with various environmental considerations. The combination of five structures was determined to most nearly meet project objectives.

Hydrologic soil cover complexes were tabulated as outlined in the SCS National Engineering Handbook, Section 4 (NEH-4). Curve numbers for open land were developed by the Soil Conservation Service and the U.S. Forest Service computed curve numbers for forest land.

Runoff was determined as outlined in the Soil Conservation Service National Engineering Handbook, Section 4 (NEH-4), with the appropriate values of rainfall and runoff curve numbers.

Valley sections were located to reflect flood stage at points of damage, restrictions, grade control and typical sections for area inundation calculations. Channel and valley sections were obtained by field survey. High water-mark elevations were secured for respective storms when available and referenced to the corresponding section.

Time of concentration of subareas and sites was based on channel hydraulics. Channel sections were surveyed and bank-full velocities were computed. Overland flow was computed using Soil Conservation Service Memo WS-Hydrol, EWP-1 (UD). These were combined to get T_c 's for the sites and subareas.

The watershed was divided into subareas to reflect economic and hydrologic characteristics, soils and cover. Routings were performed using the IBM electronic computer and procedures outlined in Soil Conservation Service Technical Release No. 20. The 100-, 50-, 25-, 10-, 5-, 2-year, and 1-day storms were routed to establish discharge-frequency relationships. The key flood (March, 1942) was routed, and routed peaks were used to verify discharge-frequency relationships. The hydrologic effect of changed land use and treatment was determined by using the simplified procedure outlined in SCS Memo WS-Hydrol, EWP-2 (UD).

Structures Nos. 27, 23, 4, and 10, are two-stage flood prevention. Structure No. 16 is a two-stage, multiple-purpose structure. All structures are class "C", designed with storage figures in excess of NEH-4, Chapter 21, and Washington Engineering Memo-27 requirements since the antecedent moisture condition, 2-1/2 runoff curve number was used.

Geologic Investigations

Preliminary geologic investigations were made of all potential structure sites. These investigations were made using outcrops, roadcuts, soil auger and backhoe. Available geologic maps, soil maps and literature were studied. Geologic maps and profiles of the sites were prepared using the information obtained.

Surface rocks are all of sedimentary origin and consist of limestone, sandstone and shale. The age ranges from the Carboniferous to Ordovician Periods. These rocks are folded into a number of anticlines and synclines between two major geologic structures, the Sideling Hill Syncline on the west and the Adams Run Anticline on the east.

The preliminary earthquake investigation included location of the watershed on the Seismic Risk Map from Algermissen's 1969 Seismic Risk Map of U.S., a review of earthquake records in "Earthquake History of the United States", Part I ESSA, 1965; a review of earthquake history and intensity in Peter Lessing's "Earthquake History of West Virginia", Environmental Geology Bulletin 12, W. Va. Geological and Economic Survey, 1974; a review of geologic maps for evidence of active faulting or areas of crustal movement, and a study of the geology of the watershed and proposed structural sites to identify critical materials or geologic conditions that pose as earthquake hazards.

Sediment storage requirements for the structures were computed for a 100-year design life. Soil survey maps and field inspection were used to determine the soil type, slope, erosion and cover conditions. The amount of sheet erosion was calculated using Musgrave's "Probable Soil Loss Formula." Sediment delivery rates and trap efficiency were determined using procedures contained in Soil Conservation Service Technical Release No. 12 for each site.

Structures Nos. 4 and 16 are located in Devonian shales. These sites are similar geologically to many other structures already constructed in eastern West Virginia. Due to the large volume of borrow material required for construction, test pits were dug to determine approximate quantities and kinds of material available at both sites. It was determined that suitable material in sufficient quantities is available at both sites.

Structures Nos. 10 and 23 are located in the Upper Devonian Hampshire and Chemung Formations consisting of sandstone and interbedded shales. Structure No. 27 is located near the axis of the Adams Run Anticline in the Martinsburg Formation (Ordovician). No adverse geologic conditions were encountered at these sites.

A bottomland damage survey was conducted using the Range Method. Physical damage from scour and infertile overwash for specific flood events was estimated in the field. Relative amounts of damage as related to crop yields and expected recovery rates were estimated jointly by the economist and geologist. Damage reduction due to structural measures was determined by the reduction in area and depth of flooding for specific flood events.

Sediment delivered to the Potomac River and Potomac Estuary was determined using standard SCS procedures for computing the sediment yield from small watersheds. The reduction in sediment yield of the subwatershed was determined using area controlled and trap efficiency of the reservoirs.

The most valuable mineral resource of the area is limestone. It is abundant and suitable for many uses. There are a few gas wells on the western side of Lost River used both for production and storage. Potential for development of a large producing field in this area is not good at present. Large transmission lines cross the area and limited the selection of sites on Upper Cove Run and practically eliminated the selection of a suitable site on Howards Lick. There are no mineable coals or potentially mineable metallic ores.

Fish and Wildlife

The West Virginia Department of Natural Resources, Division of Wildlife Resources, and the Soil Conservation Service jointly investigated the fish and wildlife aspects of this project. The investigation process included gathering existing information about the streams, fisherman and hunter use figures and problems. The U.S. Fish and Wildlife Service was notified in advance of the start of planning, but was unable to participate due to work commitments, personnel, and finances.

An initial field investigation was made to get an overall idea of the habitat conditions. As the watershed planning party progressed with more detailed information, other biology reviews were made jointly. Department of Natural Resources biologists and SCS biologists mutually agreed to certain modifications of the structure water release to protect downstream trout fishing. These modifications have been incorporated into the design of Structures Nos. 4 and 16. Investigations were undertaken, without success, to try to insure that the various structures would be open to the public. The Department of Natural Resources, Division of Wildlife Resources, has approved this plan with the modifications suggested.

Recreation

The need for additional developed recreation was recognized by the Sponsors and was established as a project objective. This need is supported by several studies of reports, one of which was made by the Bureau of Outdoor Recreation during the Appalachian Water Resource Study. The Sponsors investigated financial and management assistance from the West Virginia Department of Natural Resources, Division of State Parks, and the George Washington National Forest. Both agencies were unable to become legal Sponsors because of prior commitments, but expressed agreement for the need for such a recreational facility. The Soil Conservation Service evaluated various sites for development for the Sponsors. Structure No. 16 was selected as the more desirable, and a soils interpretation was prepared for field use to determine the best land use plan. With sponsorship assured by the Hardy County Court and Parks and Recreation Commission, a recreation development plan was prepared. This plan included site map, cost estimates, sewage and drinking water plans and other details which were approved by the Sponsors.

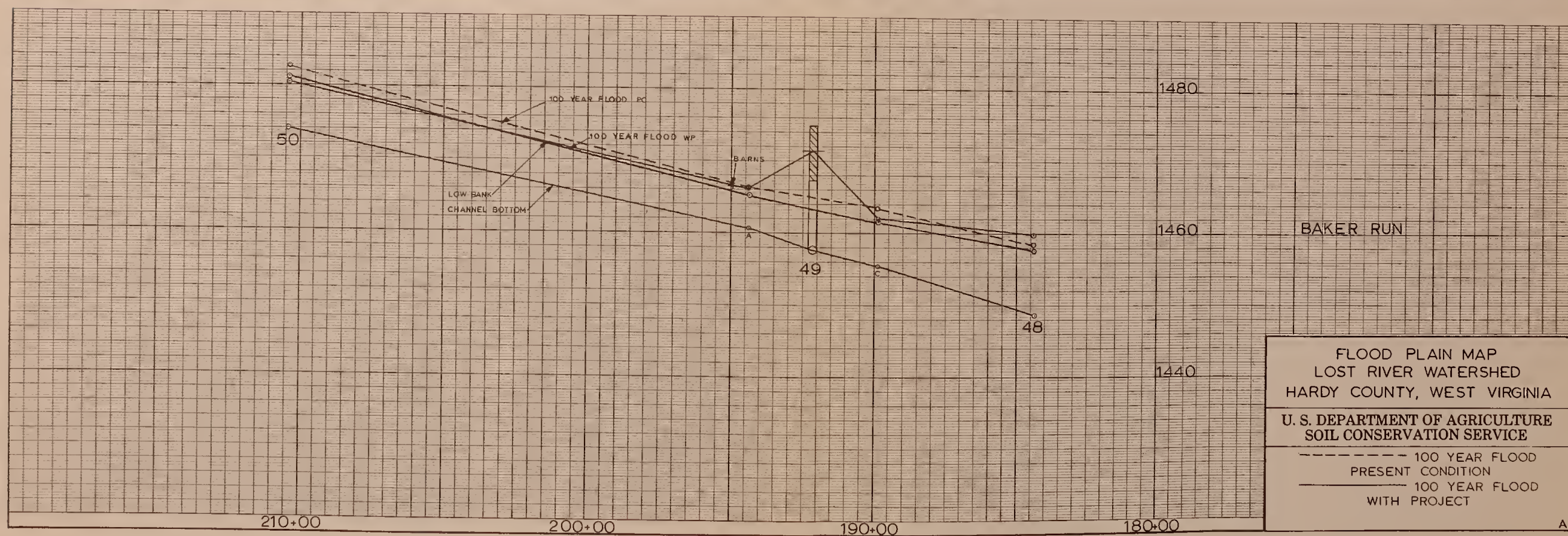
During final planning of this project, the State Health Department will assist with investigating water quality for swimming purposes. The drainage area of Structure No. 16 has farms and homes that may cause future sanitary problems. Investigations have shown water quality to be satisfactory at present and in the foreseeable future. Additional coordination during final design and construction will be necessary to assure borrow removal and water quality is compatible with the recreation development plan prior to federal commitments to cost-sharing.

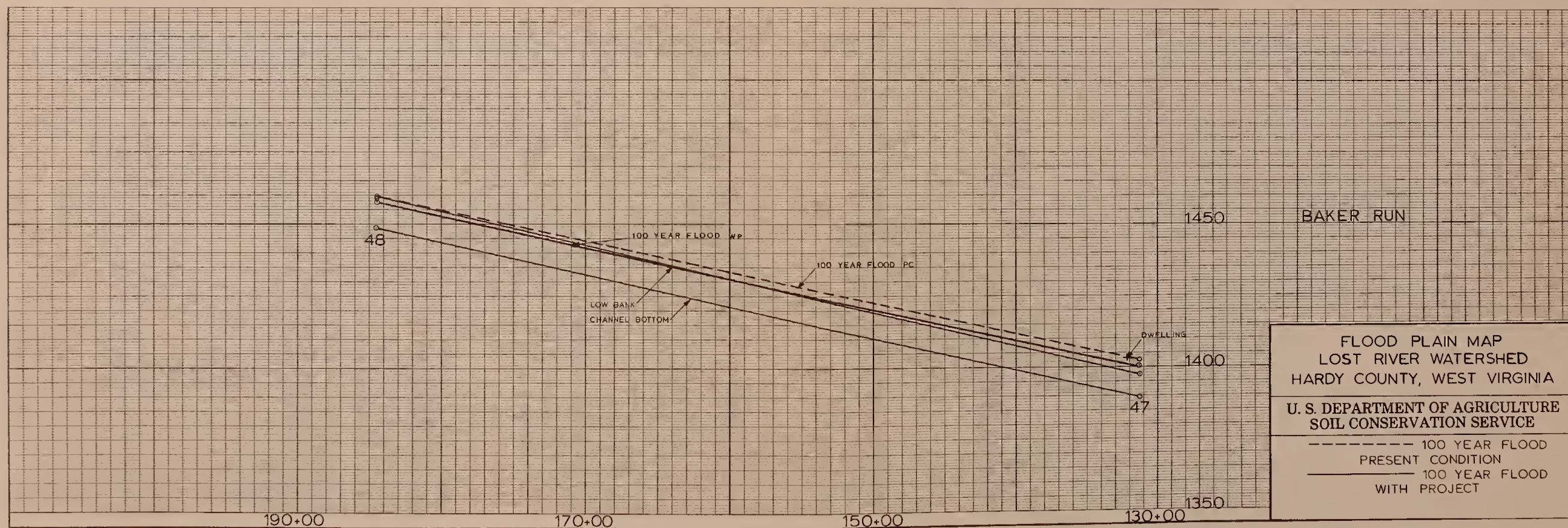
Archeological, Historical, and Scientific Investigations

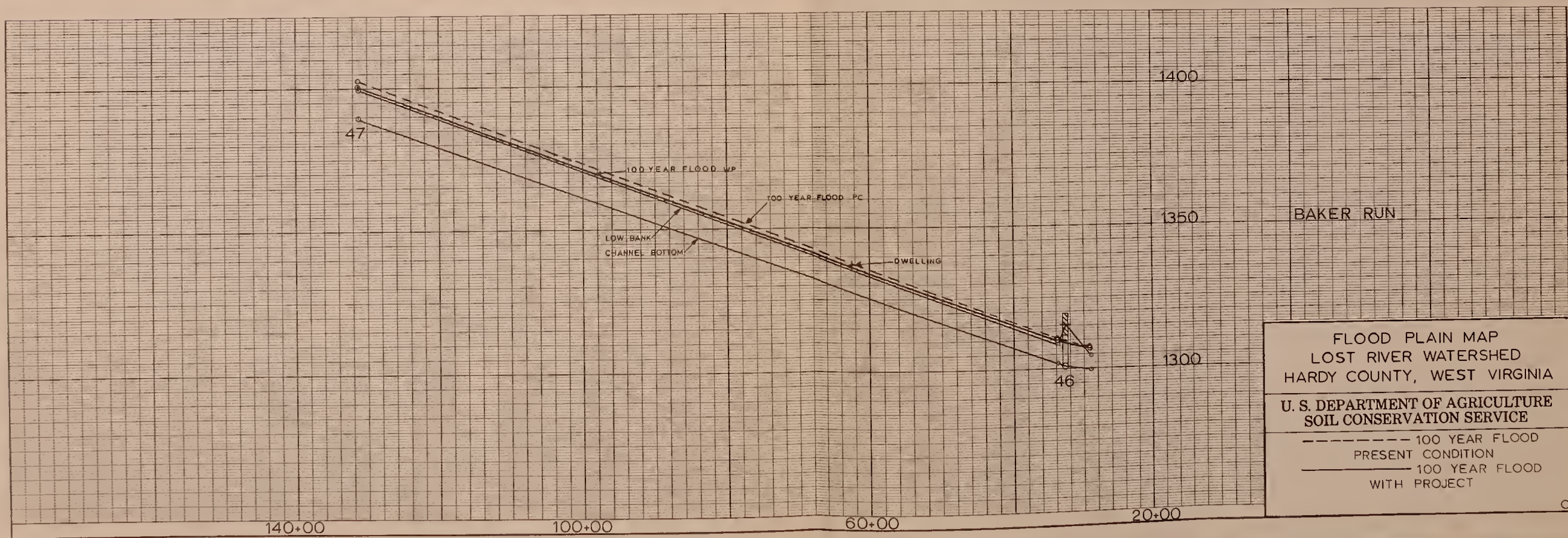
Archeological, historical, and scientific investigations were conducted by the Archeology Section of the West Virginia Economic and Geologic Survey under contract with the Soil Conservation Service. These investigations were initiated at the beginning of planning and concluded after project formulation. Analyses included a thorough examination of maps, historic records, other documents, and field trips. This effort was made to evaluate the impacts of the planned project on these features.

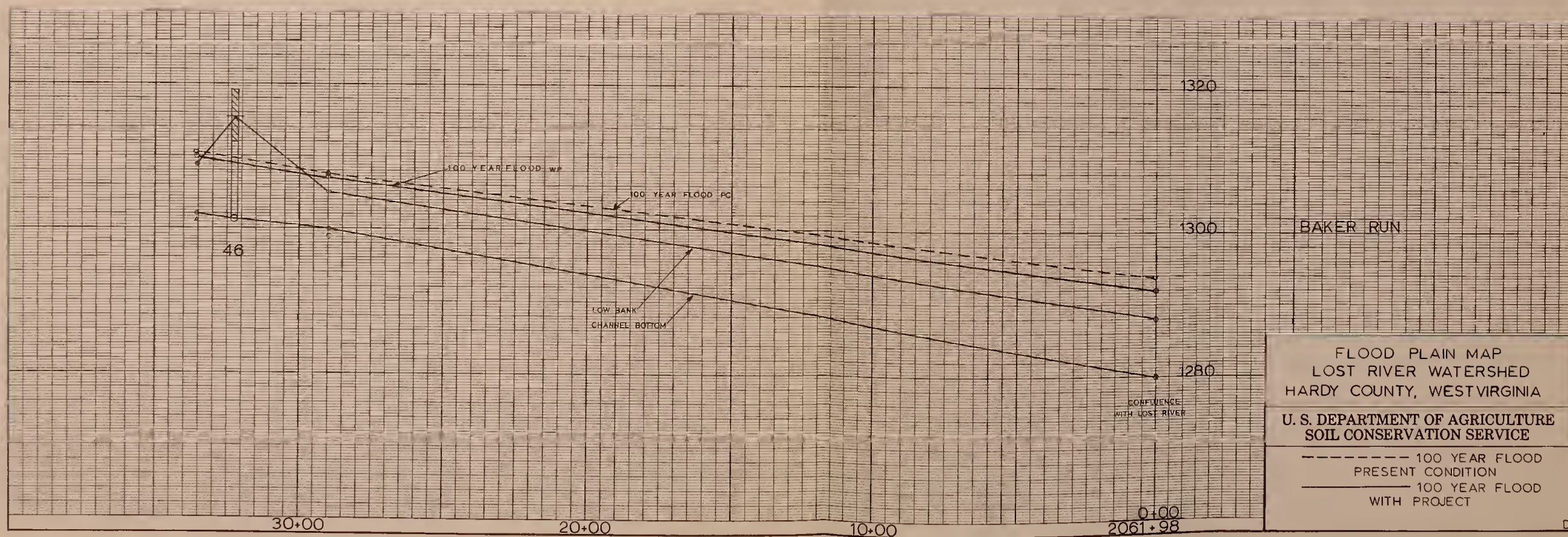
Archeological studies included both ancient and prehistoric civilizations. The analyses consisted of a study of site maps above each flood retarding structure. An extensive search was made for Indian campsites in the area. No archeological values were discovered that will be adversely affected by the planned project.

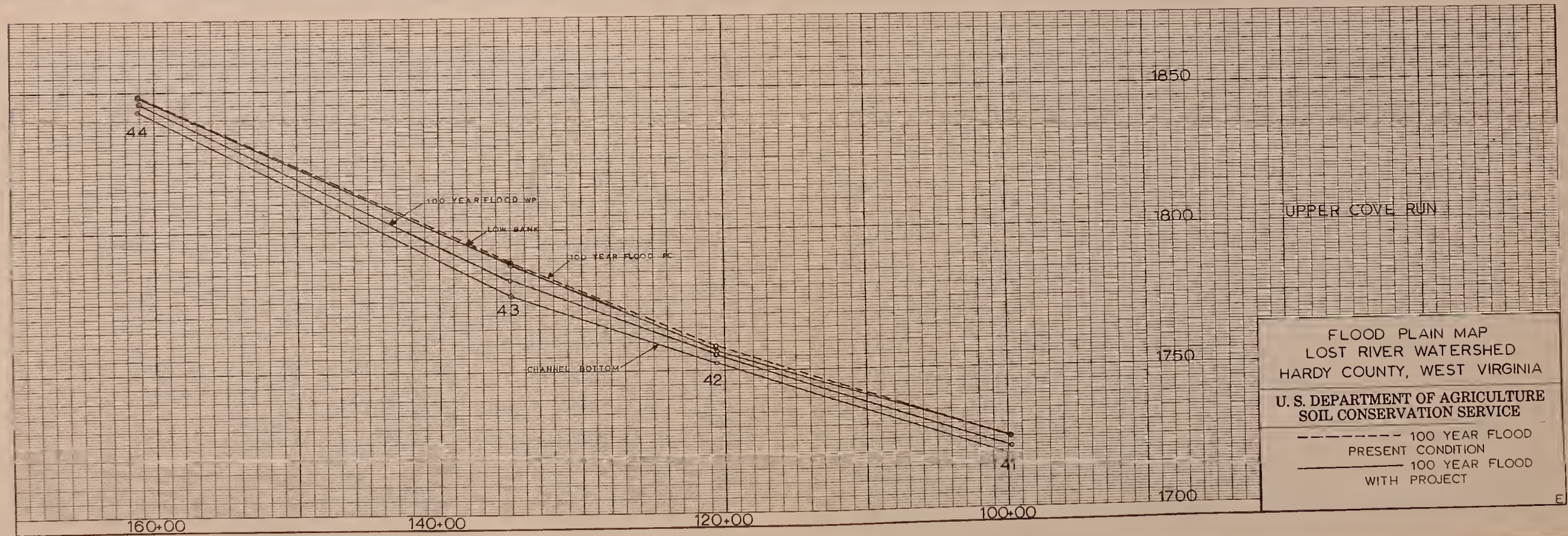
Historical investigations consisted of a search of the National Register of Historic Places, local records, and field reviews.

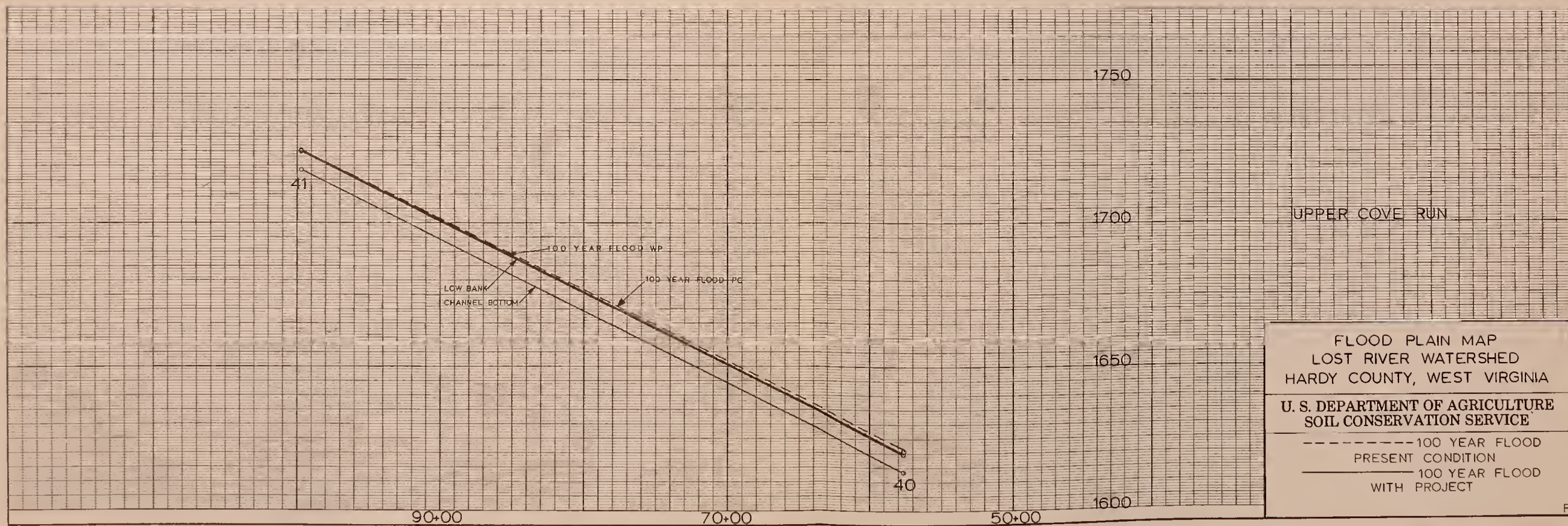
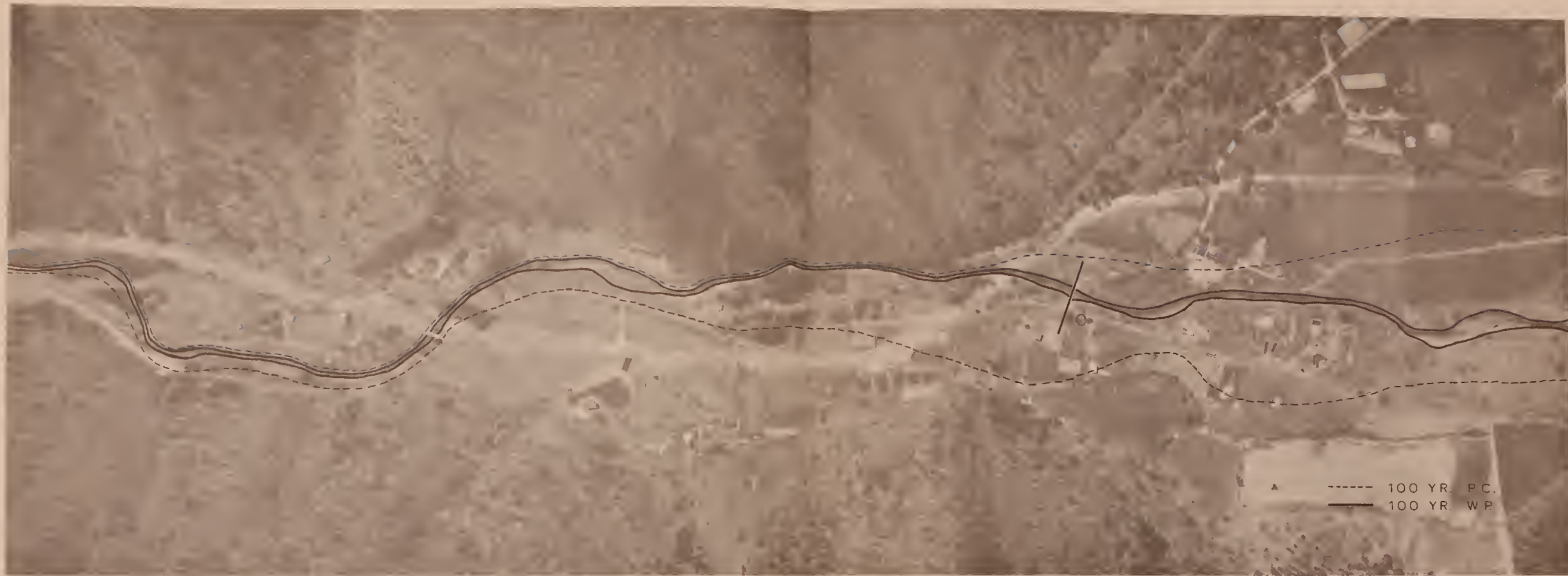


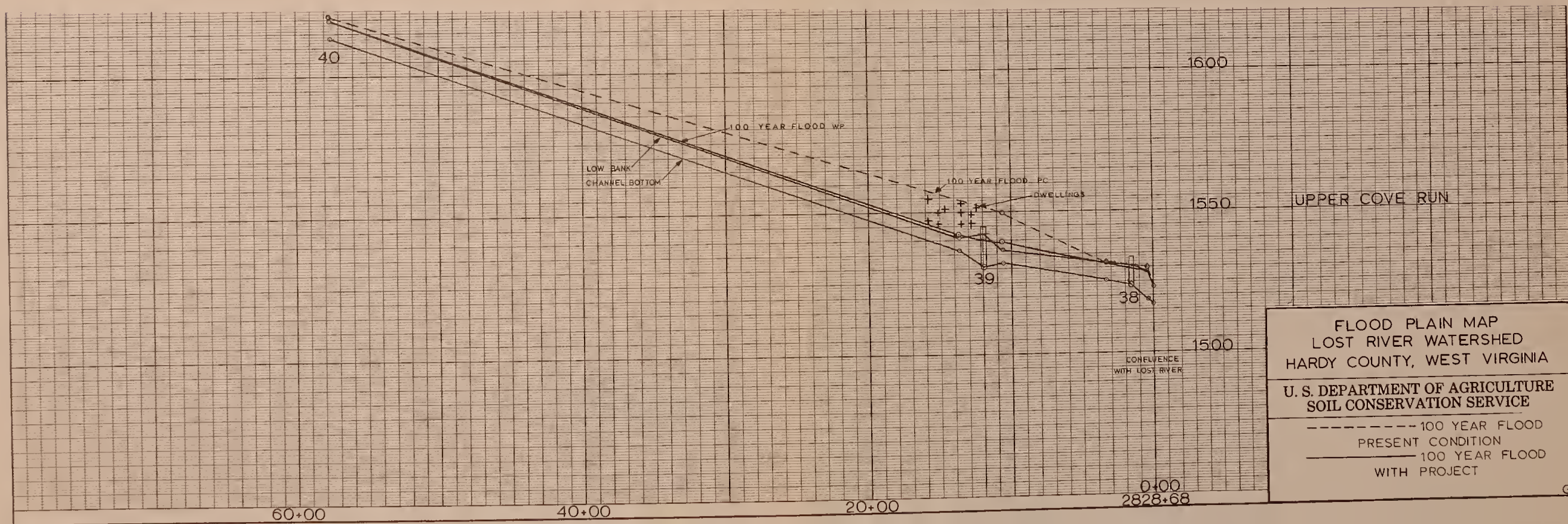


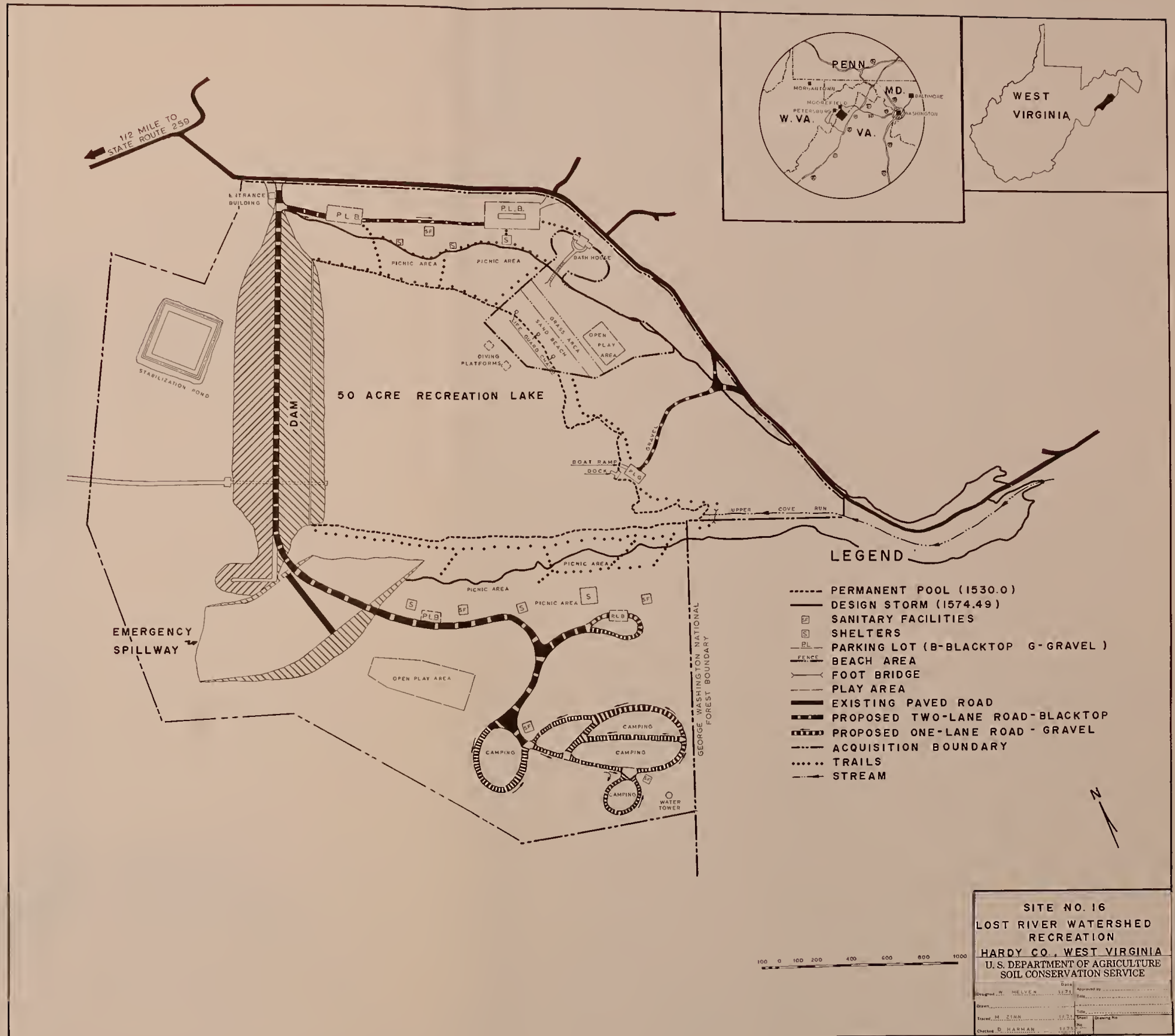


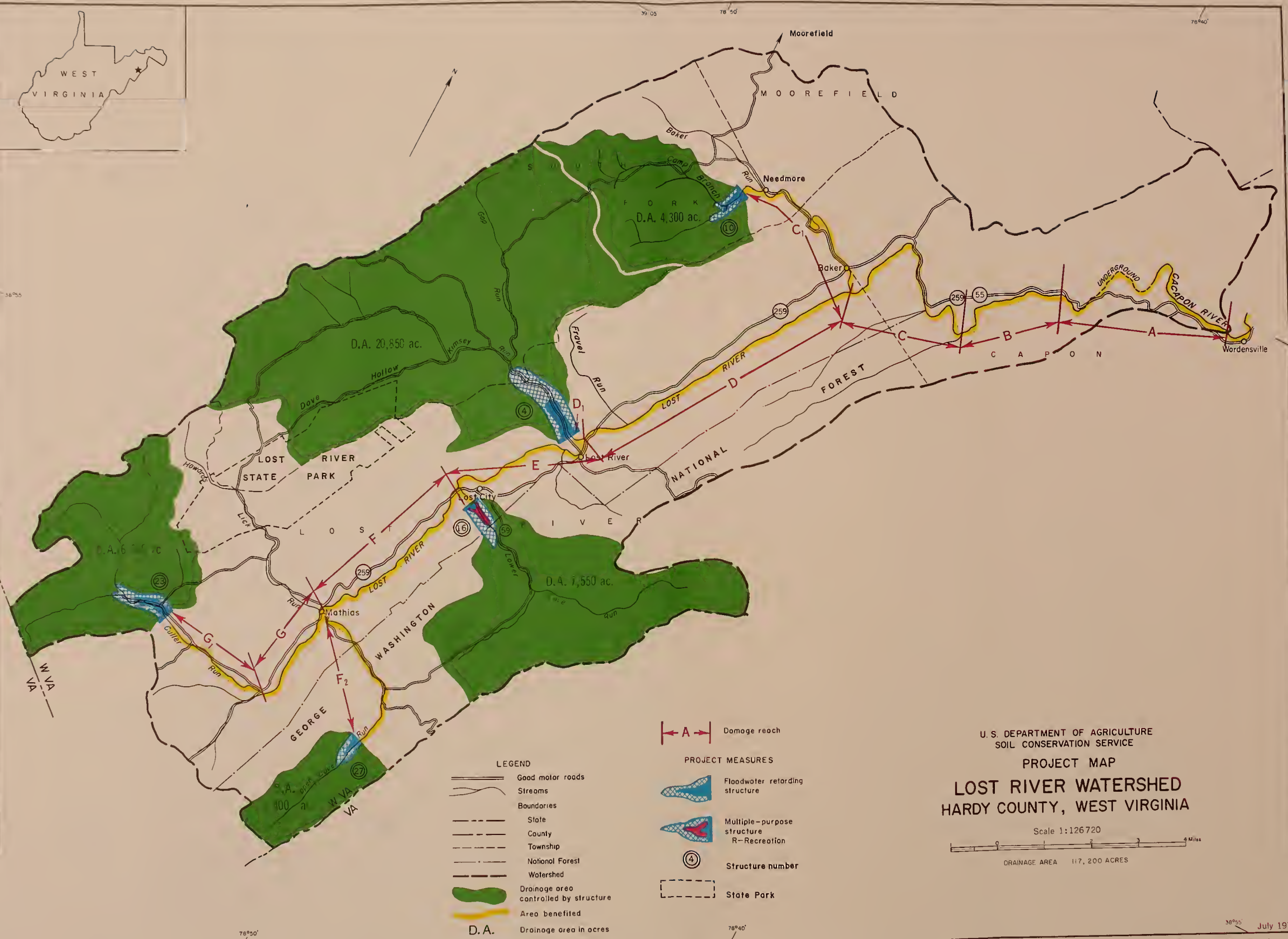


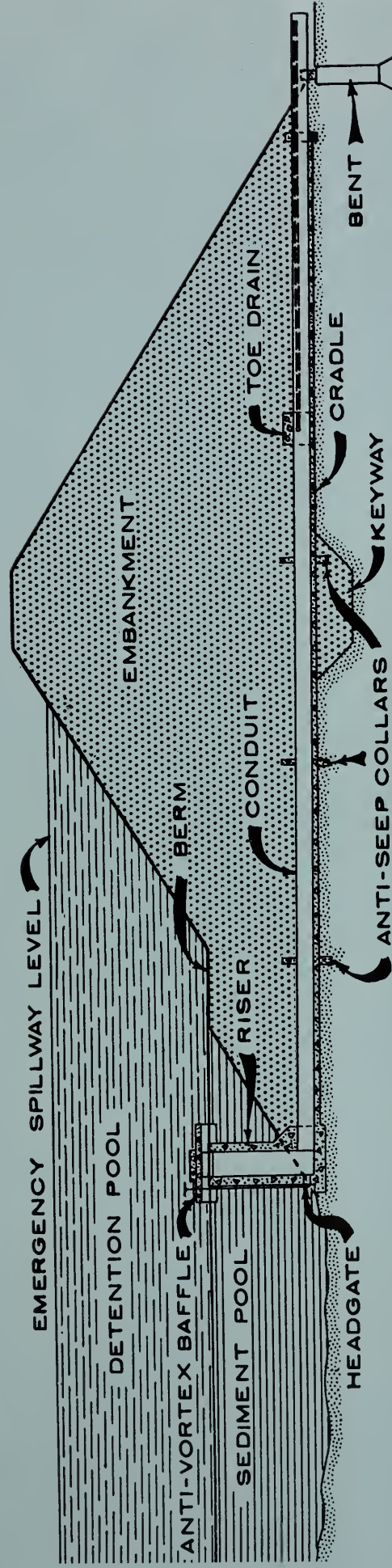












SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

